LUNG CANCER (NON-SMALL CELL)

What is cancer?

Cancer develops when cells in a part of the body begin to grow out of control. Although there are many kinds of cancer, they all start because of out-of-control growth of abnormal cells.

Normal body cells grow, divide, and die in an orderly fashion. During the early years of a person's life, normal cells divide more rapidly until the person becomes an adult. After that, cells in most parts of the body divide only to replace worn-out or dying cells and to repair injuries.

Because cancer cells continue to grow and divide, they are different from normal cells. Instead of dying, they outlive normal cells and continue to form new abnormal cells.

Cancer cells develop because of damage to DNA. This substance is in every cell and directs all its activities. Most of the time when DNA becomes damaged the body is able to repair it. In cancer cells, the damaged DNA is not repaired. People can inherit damaged DNA, which accounts for inherited cancers. Many times though, a person’s DNA becomes damaged by exposure to something in the environment, like smoking.

Cancer usually forms as a tumor. Some cancers, like leukemia, do not form tumors. Instead, these cancer cells involve the blood and blood-forming organs and circulate through other tissues where they grow.

Often, cancer cells travel to other parts of the body, where they begin to grow and replace normal tissue. This process is called metastasis. Regardless of where a cancer may spread, however, it is always named for the place it began. For instance, breast cancer that spreads to the liver is still called breast cancer, not liver cancer.

Not all tumors are cancerous. Benign (non-cancerous) tumors do not spread (metastasize) to other parts of the body and, with very rare exceptions, are not life threatening.

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.

Cancer is the second leading cause of death in the United States. Nearly half of all men and a little over one third of all women in the United States will develop cancer during their lifetimes. Today, millions of people are living with cancer or have had cancer. The risk of developing most types of cancer can be reduced by changes in a person's lifestyle, for example, by quitting smoking and eating a better diet. The sooner a cancer is found and treatment begins, the better are the chances for living for many years.

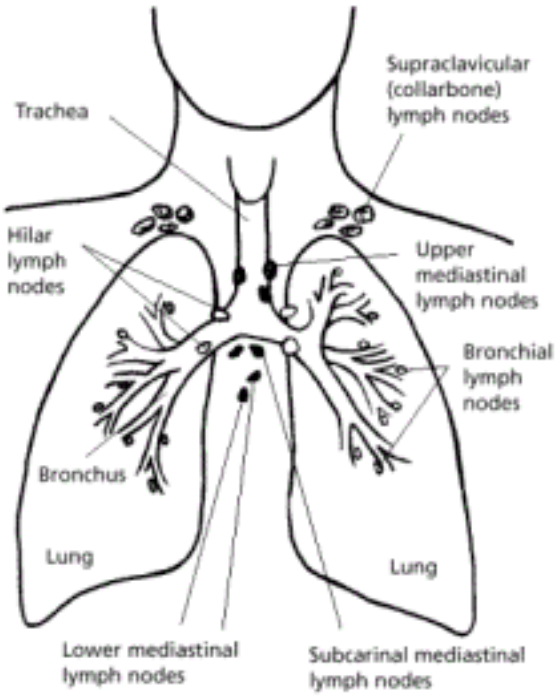
What Is Non-Small Cell Lung Cancer?

Note: This document is specifically for the non-small cell type of lung cancer. The treatment for each type of lung cancer (small cell vs. non-small cell) is very different, so much of the information for one type will not apply to the other type. If you are not sure which type of lung cancer you have, it is very important to ask you doctor so you can be sure the information you receive is correct.

Lung cancer is a cancer that starts in the lungs. In order to understand lung cancer, it helps to know about the normal structure and function of the lungs.

The Lungs

Your lungs are two sponge-like organs found in your chest. Your right lung is divided into 3 sections, called lobes. Your left lung has 2 lobes. The left lung is smaller because the heart takes up more room on that side of the body.



When you breathe, air goes into your lungs through the *trachea* (windpipe). The trachea divides into tubes called the *bronchi* (singular, *bronchus*), which divide into smaller branches called *bronchioles*. At the end of the bronchioles are tiny air sacs known as *alveoli*.

Many tiny blood vessels run through the alveoli. They absorb oxygen from the inhaled air into your bloodstream and pass carbon dioxide from the body into the alveoli. This is expelled from the body when you exhale. Taking in oxygen and getting rid of carbon dioxide are your lungs' main functions.

A lining, called the *pleura*, surrounds the lungs. The pleura protects your lungs and helps them slide back and forth as they expand and contract during breathing.

Start and Spread of Lung Cancer

Most lung cancers start in the bronchi, but they can also begin in other areas such as the trachea, bronchioles, or alveoli.

Lung cancers are thought to develop over a period of many years. They may start as areas of pre-cancerous changes in the lung. These changes happen within the cells themselves, but at this point the cells do not form a mass or tumor. They cannot be seen on an x-ray and they do not cause symptoms. Over time, these pre-cancerous changes may progress to true cancer. As a cancer develops, the cancer cells may make chemicals that cause new blood vessels to form

nearby. These new blood vessels nourish the cancer cells, which can continue to grow and form a tumor large enough to be seen on imaging tests such as x-rays.

At some point, cells from the cancer may break away from the original tumor and spread to other parts of the body. As noted earlier, this process is called *metastasis*. Lung cancer is a life-threatening disease because it often spreads in this way even before it can be detected on an imaging test such as a chest x-ray.

The Lymph (Lymphatic) System

The lymph system is important to understand because it is one of the ways in which lung cancers can spread. This system has several parts.

Lymph nodes are small, bean-shaped collections of immune system cells that are connected by lymphatic vessels. *Lymphatic vessels* are like small veins, except that they carry a clear fluid called lymph (instead of blood) away from the lungs. *Lymph* contains tissue fluid and waste products, as well as immune system cells (cells that are important in fighting infections).

Lung cancer cells can enter lymphatic vessels and begin to grow in lymph nodes around the bronchi and in the *mediastinum* (the area between the 2 lungs). When lung cancer cells have reached the lymph nodes, they are more likely to have spread to other organs of the body as well. Staging and decisions about lung cancer treatment are based on whether or not the cancer has spread to the nearby lymph nodes in the mediastinum. These topics are discussed later in the section, "How Is Non-Small Cell Lung Cancer Staged?"

Types of Lung Cancer

There are 2 major types of lung cancer:

- small cell lung cancer (SCLC)
- non-small cell lung cancer (NSCLC)

If a lung cancer has characteristics of both types it is called a mixed small cell/large cell cancer. This is uncommon. The 2 types of lung cancer are discussed separately because they are treated very differently. **This document focuses on non-small cell lung cancer.** Small cell lung cancer is discussed in a separate American Cancer Society document, *Lung Cancer (Small Cell).*

Non-small Cell Lung Cancer

About 85% to 90% of lung cancers are non-small cell lung cancer (NSCLC). There are 3 subtypes of NSCLC. The cells in these subtypes differ in size, shape, and chemical make-up when looked at under a microscope.

Squamous cell carcinoma: About 25% to 30% of all lung cancers are squamous cell carcinomas. They are often linked to a history of smoking and tend to be found in the middle of the lungs, near a bronchus.

Adenocarcinoma: This type accounts for about 40% of lung cancers. It is usually found in the outer region of lung. People with one type of adenocarcinoma, sometimes called *bronchioloalveolar carcinoma*, tend to have a better outlook (prognosis) than those with other types of lung cancer.

Large-cell (undifferentiated) carcinoma: This type of cancer accounts for about 10% to 15% of lung cancers. It may appear in any part of the lung. It tends to grow and spread quickly, which can make it harder to treat effectively.

Other Types of Lung Cancer

Along with the 2 main types of lung cancer, other tumors can occur in the lungs.

Carcinoid tumors of the lung account for fewer than 5% of lung tumors. Most are slow-growing tumors that are called typical carcinoid tumors. They are generally cured by surgery. Although some typical carcinoid tumors can spread, they usually have a better prognosis than small cell or non-small cell lung cancer. Less common are atypical carcinoid tumors. The outlook for these tumors is somewhere in between typical carcinoids and small cell lung cancer. For more information about typical and atypical carcinoid tumors, see the separate American Cancer Society document, *Lung Carcinoid Tumor*.

There are other, even more rare, lung tumors such as adenoid cystic carcinomas, hamartomas, lymphomas, and sarcomas. Since these tumors are treated differently from the more common lung cancers, they are not discussed in this document.

Cancer that starts in other organs (such as the breast, pancreas, kidney, or skin) and spreads (metastasizes) to the lungs is not the same as lung cancer. For example, cancer that starts in the breast and spreads to the lungs is still breast cancer, not lung cancer. Treatment for metastatic cancer to the lungs depends on where it started (the primary cancer site). For information on these cancers, refer to the specific American Cancer Society documents.

What Are the Key Statistics About Lung Cancer?

Most statistics concerning lung cancer include both small cell and non-small cell lung cancers.

Lung cancer (both small cell and non-small cell) is the second most common cancer in both men (after prostate cancer) and women (after breast cancer). It accounts for about 15% of all new cancers. During 2008, there will be about 215,020 new cases of lung cancer (114,690 among men and 100,330 among women).

Lung cancer mainly occurs in the elderly. About 2 out of 3 people diagnosed with lung cancer are older than 65; fewer than 3% of all cases are found in people under the age of 45. The average age at the time of diagnosis is about 70.

Overall, the chance that a man will develop lung cancer in his lifetime is about 1 in 13; for a woman, the risk is about 1 in 16. These numbers include both smokers and non-smokers. For smokers the risk is much higher, while for non-smokers the risk is lower.

Black men are about 50% more likely to develop lung cancer than white men. The rate is slightly higher in black women than in white women. Both black and white women have lower rates than men, but the gap is closing. The rate of lung cancer has been dropping among men for several years and is fairly stable among women.

Lung cancer is by far the leading cause of cancer death among both men and women. There will be an estimated 161,840 deaths from lung cancer (90,810 among men and 71,030 among women) in 2008, accounting for around 29% of all cancer deaths. More people die of lung cancer than of colon, breast, and prostate cancers combined.

About 41% of people diagnosed with either type of lung cancer are still alive 1 year after their diagnosis. About 27% are still alive after 2 years. Only about 15% of people diagnosed with lung cancer survive this disease after 5 years. Statistics on survival rates based on the stage (extent) of non-small cell lung cancer are discussed in the section, "How Is Non-Small Cell Lung Cancer Staged?"

Despite the very serious prognosis of lung cancer, some people are cured. More than 400,000 people alive today have been diagnosed with lung cancer at some point in time.

What Are the Risk Factors for Non-Small Cell Lung Cancer?

A risk factor is anything that affects a person's chance of getting a disease such as cancer. Different cancers have different risk factors. For example, unprotected exposure to strong sunlight is a risk factor for skin cancer.

But risk factors don't tell us everything. Having a risk factor, or even several risk factors, does not mean that you will get the disease. And many people who get the disease may not have had any known risk factors. Even if a person with lung cancer has a risk factor, it is often very hard to know how much that risk factor may have contributed to the cancer.

Several risk factors can make you more likely to develop lung cancer:

Tobacco Smoke

Smoking is by far the leading risk factor for lung cancer. At the beginning of the 20th century, lung cancer was a rare disease. The introduction of manufactured cigarettes, which made them readily available, changed this.

About 87% of lung cancer deaths are thought to result from smoking. The risk for lung cancer among smokers is many times higher than among nonsmokers. The longer you smoke and the more packs per day you smoke, the greater your risk.

Cigar smoking and pipe smoking are almost as likely to cause lung cancer as cigarette smoking. Smoking low tar or "light" cigarettes increases lung cancer risk as much as regular cigarettes. There is concern that mentholated cigarettes may increase the risk. It is thought that the menthol may allow smokers to inhale more deeply.

If you stop smoking before a cancer develops, your damaged lung tissue gradually starts to repair itself. No matter what your age or how long you've smoked, quitting may help you live longer. People who stop smoking before age 50 cut their risk of dying in the next 15 years in half compared with those who continue to smoke.

If you don't smoke, but breathe in the smoke of others (called **secondhand smoke** or environmental tobacco smoke) you may also be at increased risk for lung cancer. A nonsmoker who lives with a smoker has about a 20% to 30% greater risk of developing lung cancer. Workers who have been exposed to tobacco smoke in the workplace are also more likely to get lung cancer. Secondhand smoke is thought to cause more than 3,000 deaths from lung cancer each year.

Some evidence suggests that certain people are more susceptible to the cancer-causing effect of tobacco smoke than others. This is in addition to families that have genetic predispositions (see below).

Hookah smoking has become popular among young people in recent years. It is often marketed as being safer than cigarettes because the percent of tobacco in the product smoked is low and the smoke is filtered through water. But it is not true that hookah smoking is safe. Studies have shown that hookah smoke contains the same cancer-causing substances as cigarettes. Furthermore, because the hookah smoke contains nicotine it is addictive and may lead to cigarette smoking in the future.

Radon

Radon is a naturally occurring radioactive gas that results from the breakdown of uranium in soil and rocks. It cannot be seen, tasted, or smelled. According to the U.S. Environmental Protection Agency (EPA), radon is the second leading cause of lung cancer, and is the leading cause among nonsmokers.

Outdoors, there is so little radon that it is not dangerous. But indoors, radon can be more concentrated and become a possible risk for cancer. Houses in some parts of the United States built over soil with natural uranium deposits can create high indoor radon levels (especially in basements). Studies from these areas have found that the risk of lung cancer is higher in those who have lived for many years in a radon-contaminated house.

The lung cancer risk from radon is much lower than that from tobacco smoke. However, the risk from radon is much higher in people who smoke than in those who don't.

State and local offices of the EPA can give you the names of reliable companies that perform radon testing and renovation. For more information, see the separate American Cancer Society document, *Radon*.

Asbestos

Workplace exposure to asbestos fibers is an important risk factor for lung cancer. Studies have found that people who work with asbestos (in some mines, mills, textile plants, insulation, shipyards, etc.) are several times more likely to die of lung cancer. In workers exposed to asbestos who also smoke, the lung cancer risk is much greater than even adding the risks from these exposures separately. It's not clear to what extent low-level or short-term exposure to asbestos might raise lung cancer risk.

Both smokers and nonsmokers exposed to asbestos also have a greater risk of developing mesothelioma, a type of cancer that starts in the pleura (the lining surrounding the lungs). Because it is not usually considered a type of lung cancer, mesothelioma is discussed in the separate American Cancer Society document, *Malignant Mesothelioma*.

In recent years, government regulations have greatly reduced the use of asbestos in commercial and industrial products. It is still present in many homes and commercial buildings but is not considered harmful as long as it is not released into the air by deterioration, demolition, or renovation.

Other Cancer-causing Agents in the Workplace

Other carcinogens (cancer-causing agents) found in the workplace that can increase lung cancer risk include:

- radioactive ores such as uranium

- inhaled chemicals or minerals such as arsenic, beryllium, cadmium, vinyl chloride, nickel compounds, chromium compounds, coal products, mustard gas, and chloromethyl ethers
- diesel exhaust

The government and industry have taken major steps in recent years to protect workers. But the dangers are still present and if you work around these agents, you should be very careful to avoid exposure.

Radiation Therapy to the Lungs

People who have had radiation therapy to the chest for cancer are at higher risk for lung cancer, particularly if they smoke. Typical patients are those treated for Hodgkin disease or women who get radiation to the chest after a mastectomy for breast cancer. Women who receive radiation therapy to the breast after a lumpectomy do not have a higher than expected risk of lung cancer. But if they smoke, their chance of lung cancer goes up markedly.

Arsenic

High levels of arsenic in drinking water may increase the risk of lung cancer. This is even more pronounced in smokers.

Certain Mineral Exposures

Silicosis and berylliosis are lung diseases caused by breathing in certain minerals. They are seen mainly in certain occupations such as mining. People with these conditions also have a higher risk of lung cancer.

Personal and Family History of Lung Cancer

If you have had lung cancer, you have a higher risk of developing another lung cancer. Brothers, sisters, and children of those who have had lung cancer may have a slightly higher risk of lung cancer themselves, especially if it was diagnosed at a younger age. It is not clear how much of this risk might be due to genetics and how much might be from shared exposures (such as tobacco smoke or radon).

Researchers have found that genetics does seem to play a role in some families with a strong history of lung cancer. People who inherit certain DNA changes in a particular chromosome (chromosome 6) are more likely to develop lung cancer, even if they only smoke a little. At this time these changes cannot be routinely tested for. Research in this area is ongoing.

Diet

Some evidence suggests that fruits and vegetables may help protect against lung cancer in both smokers and nonsmokers. But any effect of fruits and vegetables on risk would be much less than the effects of smoking.

Studies looking at the possible role of antioxidant supplements in reducing lung cancer risk have not been promising thus far. In fact, two large studies found that smokers who took beta carotene supplements actually had an *increased* risk of lung cancer. The results of these studies suggest that smokers should avoid taking beta carotene supplements.

Air Pollution

In cities, air pollution (especially from heavily trafficked roads) appears to raise the risk of lung cancer slightly. This risk is far less than that caused by smoking.

Factors With Uncertain or Unproven Effects on Lung Cancer Risk

Marijuana

There are some reasons to think that marijuana smoking might increase lung cancer risk. Marijuana contains more tar than cigarettes. Marijuana is also inhaled very deeply and the smoke is held in the lungs for a long time. Marijuana is smoked all the way to the end where tar content is the highest. Many of the cancer-causing substances in tobacco are also found in marijuana. And because marijuana is an illegal substance, it is not possible to control whether it contains pesticides and other additives.

But it has been hard to study whether there is a connection between marijuana and lung cancer because it is not easy to gather information about the use of illegal drugs. Also, many marijuana smokers also smoke cigarettes. This makes it hard to know how much of the risk is from tobacco and how much might be from marijuana. In the very limited studies done so far, marijuana use has not been strongly linked to lung cancer, but more research in this area is needed.

Talc and Talcum Powder

Talc is a mineral that in its natural form may contain asbestos. In the past, some studies suggested that talc miners and millers have a higher risk of lung cancer and other respiratory diseases because of their exposure to industrial grade talc. Recent studies of talc miners have not found an increase in lung cancer rate.

Talcum powder is made from talc. By law since 1973, all home-use talcum products (baby, body, and facial powders) have been asbestos-free. The use of cosmetic talcum powder has not been found to increase the risk of lung cancer.

Do We Know What Causes Non-Small Cell Lung Cancer?

Tobacco smoking is by far the leading cause of lung cancer. About 87% of lung cancer deaths are caused directly by smoking, and some of the rest are caused by environmental exposure to tobacco smoke. Other known risk factors were described in the section, "What Are the Risk Factors for Non-Small Cell Lung Cancer?" Still, a small portion of lung cancers occur in people with no apparent risk factors for the disease.

Scientists have begun to understand how the known risk factors may produce certain changes in the DNA of cells in the lungs, causing them to grow abnormally and form cancers. DNA is the chemical in each of our cells that makes up our *genes* -- the instructions for how our cells function. We usually resemble our parents because they are the source of our DNA. However, DNA affects more than how we look. It also can influence our risk for developing certain diseases, such as some kinds of cancer.

Some genes contain instructions for controlling when cells grow and divide. Genes that promote cell division are called *oncogenes*. Genes that slow down cell division or cause cells to die at the appropriate time are called *tumor suppressor genes*. Cancers can be caused by DNA mutations (defects) that turn on oncogenes or turn off tumor suppressor genes.

Inherited Gene Mutations

Some people inherit DNA mutations from their parents that greatly increase their risk for developing certain cancers. However, inherited mutations in oncogenes or tumor suppressor genes are not thought to cause very many lung cancers.

Still, genetics does seem to play a role in some families with a history of lung cancer. For example, some people seem to inherit a reduced ability to break down or get rid of certain types of cancer-causing chemicals, such as those found in tobacco smoke.

Other people may inherit faulty DNA repair mechanisms that make it more likely they will end up with DNA changes. Every time a cell prepares to divide into 2 new cells, it must make a new copy of its DNA. This process is not perfect, and copying errors sometimes occur. Cells normally have repair enzymes that proofread the DNA to help prevent this. People with repair enzymes that don't work as well might be especially vulnerable to cancer-causing chemicals and radiation.

Researchers are developing tests that may help identify such people, but these tests are not yet reliable enough for routine use. Therefore, doctors recommend that all people avoid tobacco smoke and hazardous industrial chemicals.

Acquired Gene Mutations

Gene mutations related to lung cancer usually develop during life rather than before birth as an inherited mutation.

Acquired mutations in lung cells often result from exposure to cancer-causing chemicals in tobacco smoke. Acquired changes in genes, such as the p53 tumor suppressor gene and the RAS oncogene, are thought to be important in the development of lung cancer. Changes in these and similar genes may also make some lung cancers likely to grow and invade more rapidly than others.

Can Non-Small Cell Lung Cancer Be Prevented?

The best way to reduce your risk of lung cancer is not to smoke and to avoid breathing in other people's smoke. If you would like help quitting smoking, call the American Cancer Society at 1-800-ACS-2345.

Radon is an important cause of lung cancer. Exposure to radon can be reduced or eliminated by having your home tested and treated, if needed. For more information, see the separate American Cancer Society document, *Radon*.

Avoiding exposure to known cancer-causing chemicals, in the workplace and elsewhere, can also be helpful. For people working where these exposures are common, exposure should be kept to a minimum.

A healthy diet with lots of fruits and vegetables may also help prevent lung cancer.

Attempts to reduce the risk of lung cancer in current or former smokers by giving them high doses of vitamins or vitamin-like drugs have not been successful. In fact, some studies have found that beta-carotene, a nutrient related to vitamin A, appears to increase the rate of lung cancer in these people.

Some people who get lung cancer do not have any apparent risk factors. Although we know how to prevent most lung cancers, at this time we don't know how to prevent all of them.

Can Non-Small Cell Lung Cancer Be Found Early?

Usually symptoms of lung cancer do not appear until the disease is already in an advanced stage. But some lung cancers are diagnosed early because they are found as a result of tests for other medical conditions. For example, a diagnosis may be made by imaging tests (such as a chest x-ray or chest CT scan), bronchoscopy (viewing the inside of bronchi through a flexible lighted tube), or sputum cytology (microscopic examination of cells in coughed up phlegm) done for other reasons in patients with heart disease, pneumonia, or other lung conditions.

Screening for Lung Cancer

Screening is the use of tests or exams to detect a disease in people without symptoms of that disease. For example, the Pap test is used to screen for cervical cancer. Because lung cancer usually spreads beyond the lungs before causing any symptoms, an effective screening program to detect lung cancer early could save many lives.

So far, no lung cancer screening test has been shown to prevent people from dying of this disease. Studies of chest x-rays and sputum cytology have concluded that these tests could not find many lung cancers early enough to improve a person's chance for a cure. For this reason, lung cancer screening has not been recommended as a routine practice for the general public or even for people at increased risk, such as smokers.

Recently, a special type of CT scan known as spiral or helical CT has shown promise in detecting early lung cancers in smokers and former smokers. But it is not known whether this test will lower the chances of dying from lung cancer. A major drawback of this test is that it finds a lot of abnormalities that turn out not to be cancer but that still need to be tested to be sure. This may lead to unnecessary and invasive tests such as biopsies, or even surgery.

A large clinical trial called the National Lung Screening Trial (NLST) is now testing whether spiral CT scanning of people at high risk of lung cancer will save lives. The results of this study, which includes about 50,000 people, are not expected until 2009. Until this information is available, people who are interested in testing should understand the limits and benefits of screening with spiral CT.

No major professional organizations, including the American Cancer Society, currently recommend routine screening for lung cancer.

The American Cancer Society recommends that, as much as possible, people who were smokers, are current smokers, have been exposed to secondhand smoke, or have worked around materials that increase the risk for lung cancer, be aware of their continuing lung cancer risk. These individuals should talk with their doctors about their likelihood of developing lung cancer and about the potential benefits and risks of lung cancer screening. After a discussion about what is and is not known about the value of testing for early lung cancer detection, if you and your doctor decide in favor of testing, then be sure to chose an

institution that has experience in lung scanning and that supports a multidisciplinary program dedicated to the evaluation of high-risk individuals.

The United States Preventive Services Task Force (USPSTF), a group of experts gathered together by the U.S. government, recently concluded that there's not enough evidence at this time to recommend for or against lung cancer screening in people without symptoms.

The American College of Chest Physicians (ACCP) does not recommend routine lung cancer screening at this time, recommending that "individuals undergo screening only when it is administered as a component of a well-designed clinical trial."

People who are current smokers should realize that the best way to avoid dying from lung cancer is to stop smoking. This is the surest route to good health.

How Is Non-Small Cell Lung Cancer Diagnosed?

Common Signs and Symptoms of Lung Cancer

Although most lung cancers do not cause any symptoms until they have spread too far to be cured, symptoms do occur in some people with early lung cancer. If you go to your doctor when you first notice symptoms, your cancer might be diagnosed and treated while it is in a curable stage. Or, at the least, you could live longer with a better quality of life. The most common symptoms of lung cancer are:

- a cough that does not go away
- chest pain that is often worse with deep breathing, coughing, or laughing
- hoarseness
- weight loss and loss of appetite
- bloody or rust-colored sputum (spit or phlegm)
- shortness of breath
- recurring infections such as bronchitis and pneumonia
- new onset of wheezing

When lung cancer spreads to distant organs, it may cause:

- bone pain
- neurologic changes (such as headache, weakness or numbness of a limb, dizziness, or recent onset of a seizure)
- jaundice (yellowing of the skin and eyes)
- lumps near the surface of the body, due to cancer spreading to the skin or to lymph nodes (collections of immune system cells) in the neck or above the collarbone

Some lung cancers can cause a group of very specific symptoms. These are often described as "syndromes."

Horner Syndrome

Cancer of the top part of the lungs (sometimes called Pancoast tumors) may damage a nerve that passes from the upper chest into your neck. Their most common symptom is severe shoulder pain. Sometimes they also cause a group of symptoms called *Horner syndrome*:

- drooping or weakness of one eyelid
- having a smaller pupil (dark part in the center of the eye) in the same eye
- reduced or absent sweating on the same side of the face

Conditions other than lung cancer can also cause Horner syndrome.

Paraneoplastic Syndromes

Some lung cancers may make hormone-like or other substances that enter the bloodstream and cause problems with distant tissues and organs, even though the cancer has not spread to those tissues or organs. These problems are called *paraneoplastic syndromes*. Sometimes these syndromes may be the first symptoms of early lung cancer. Because the symptoms affect other organs, patients and their doctors may suspect at first that diseases other than lung cancer cause them.

The most common paraneoplastic syndromes caused by non-small cell lung cancer are:

- high blood calcium levels (hypercalcemia), which can cause frequent urination, constipation, weakness, dizziness, confusion, and other nervous system problems
- excess growth of certain bones, especially those in the finger tips, which is often painful
- blood clots
- excess breast growth in men (gynecomastia)

Most of the symptoms listed above are more likely to be caused by conditions other than lung cancer. Still, if you have any of these problems, it's important to see your doctor right away so the cause can be found and treated, if needed.

Medical History and Physical Exam

If you have any signs or symptoms that suggest you might have lung cancer, your doctor will want to take a medical history (health-related interview) to check for risk factors and

symptoms. Your doctor will also examine you to look for signs of lung cancer and other health problems.

If symptoms and/or the results of the physical exam suggest lung cancer might be present, more involved tests will likely be done. These might include imaging tests and/or getting biopsies of lung tissue.

Imaging Tests

Imaging tests use x-rays, magnetic fields, or radioactive substances to create pictures of the inside of your body. Imaging tests may be done for a number of reasons, including to help find out whether a suspicious area might be cancerous, to learn how far cancer may have spread, and to help determine if treatment has been effective.

Chest X-ray

This is often the first test your doctor will order to look for any masses or spots on the lungs. A plain x-ray of your chest can be done in any outpatient setting. If the x-ray is normal, you probably don't have lung cancer. If something suspicious is seen, your doctor may order additional tests.

Computed Tomography (CT) Scan

The CT or CAT scan is an x-ray test that produces detailed cross-sectional images of your body. Instead of taking one picture, like a regular x-ray, a CT scanner takes many pictures as it rotates around you while you lie on a table. A computer then combines these pictures into images of slices of the part of your body being studied. Unlike a regular x-ray, a CT scan creates detailed images of the soft tissues in the body.

After the first set of pictures is taken you may be asked to drink a contrast solution or receive an IV (intravenous) line through which a contrast dye is injected. This helps better outline structures in your body. A second set of pictures is then taken.

The contrast may cause some flushing (a feeling of warmth, especially in the face). Some people are allergic and get hives. Rarely, more serious reactions like trouble breathing or low blood pressure can occur. Be sure to tell the doctor if you have ever had a reaction to any contrast material used for x-rays.

CT scans take longer than regular x-rays. You need to lie still on a table while they are being done. During the test, the table moves in and out of the scanner, a ring-shaped machine that completely surrounds the table. You might feel a bit confined by the ring you have to lie in while the pictures are being taken.

In recent years, *spiral CT* (also known as helical CT) has become available in many medical centers. This type of CT scan uses a faster machine. The scanner part of the machine rotates around the body continuously, allowing doctors to collect the images much more quickly than standard CT. As a result, you do not have to hold your breath for as long while the image is taken. This lowers the chance of "blurred" images occurring as a result of breathing motion. It also lowers the dose of radiation received during the test. The "slices" it images are thinner, which yields more detailed pictures.

A CT scan can provide precise information about the size, shape, and position of any tumors and can help find enlarged lymph nodes that might contain cancer that has spread from the lung. CT scans are more sensitive than routine chest x-rays in finding early lung cancers.

This test can also be used to look for masses in the adrenal glands, brain, and other internal organs that may be affected by the spread of lung cancer.

In some cases, a CT scan can be used to guide a biopsy needle precisely into a suspected area of cancer spread. For a *CT-guided needle biopsy,* you remain on the CT scanning table, while a radiologist advances a biopsy needle toward the location of the mass. CT scans are repeated until the doctors can see that the needle is within the mass. A biopsy sample is then removed and looked at under a microscope.

Magnetic Resonance Imaging (MRI) Scan

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 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 better see details.

MRI scans are a little more uncomfortable than CT scans. First, they take longer -- often up to an hour. Second, you have to lie inside a narrow tube, which is confining and can upset people with claustrophobia (a fear of enclosed spaces). Newer, "open" MRI machines can sometimes help with this if needed. The machine also makes buzzing and clicking noises that you may find disturbing. Some centers provide headphones with music to block this out.

MRI scans are most often used to look for possible spread of lung cancer to the brain or spinal cord.

Positron Emission Tomography (PET) Scan

PET scans involve injecting glucose (a form of sugar) that contains a radioactive atom into the blood. The amount of radioactivity used is very low. Because cancer cells in the body are growing rapidly, they absorb large amounts of the radioactive sugar. A special camera can then create a picture of areas of radioactivity in the body. The picture is not finely detailed like a CT or MRI scan, but it provides helpful information about your whole body.

This test can be a very important test if you have early stage lung cancer. Your doctor can use this test to see if the cancer has spread to lymph nodes. It is also helpful in getting a better idea whether an abnormal area on your chest x-ray may be cancer.

PET is also useful if your doctor thinks the cancer may have spread but doesn't know where. PET can reveal spread of cancer to the liver, bones, and adrenal glands. It is not as useful for looking at the brain, since all brain cells use a lot of glucose.

Some newer machines are able to perform both a PET and CT scan at the same time (PET/CT scan). This allows the radiologist to compare areas of higher radioactivity on the PET with the appearance of that area on the CT.

Bone Scan

A bone scan can help show if a cancer has metastasized (spread) to your bones. For this test, a small amount of low-level radioactive material is injected into a vein (intravenously, or IV). The substance settles in areas of damaged bone throughout the entire skeleton over the course of a couple of hours. You then lie on a table for about 30 minutes while a special camera detects the radioactivity and creates a picture of your skeleton.

Areas of active bone changes appear as "hot spots" on your skeleton -- that is, they attract the radioactivity. These areas may suggest the presence of metastatic cancer, but arthritis or other bone diseases can also cause the same pattern. To distinguish between these conditions, your cancer care team may use other imaging tests such as simple x-rays or MRI scans to get a better look at the areas that light up, or they may even take biopsy samples of the bone.

PET scans, which are often done in patients with non-small cell lung cancer, can usually show the spread of cancer to bones, so bone scans aren't needed very often. Bone scans are done mainly when there is reason to think the cancer may have spread to the bones (because of symptoms, etc.) and other test results aren't clear.

Procedures That Sample Tissues and Cells

The actual diagnosis of non-small cell lung cancer is made by looking at lung cells under a microscope. The cells can be obtained from lung secretions (phlegm) or by removing the cells from a suspicious area (known as a biopsy). One or more of the tests below may be used to determine if a lung mass seen on imaging tests is indeed lung cancer. These tests can also

be used to tell the exact type of lung cancer you may have and to help determine how far it may have spread.

A pathologist, a doctor who specializes in lab tests to diagnose diseases such as cancer, will examine the cells using a microscope. If you have any questions about your pathology results or any diagnostic tests, do not hesitate to ask your doctor. If needed, you can get a second opinion of your pathology report, called a pathology review, by having your tissue specimen sent to a pathologist at another lab recommended by your doctor.

Sputum Cytology

A sample of phlegm (mucus you cough up from the lungs) is examined under a microscope to see if cancer cells are present. The best way to do this is to get early morning samples from you 3 days in a row.

Fine Needle Aspiration (FNA) Biopsy

A needle biopsy can often be used to get a small sample of cells from a suspicious area. For this test, the skin where the needle is to be inserted is first numbed with local anesthesia. The doctor directs a hollow needle into the area while looking at your lungs with either fluoroscopy (which is like an x-ray, but the image is shown on a screen rather than on film) or CT scans. Unlike fluoroscopy, CT doesn't provide a continuous picture, so the needle is inserted in the direction of the mass, a CT image is taken, and the direction of the needle is guided based on the image. This is repeated a few times until the needle is within the mass.

A tiny sample of the target area is sucked into a syringe and looked at under the microscope to see if cancer cells are present.

One possible complication of this procedure is that air may leak out of the lung at the biopsy site. This can cause part of the lung to collapse and can cause trouble breathing. This complication often gets better without any treatment. If not, it is treated by putting a small tube into the chest space and sucking out the air over a day or two.

A thin needle can also be inserted through the wall of the trachea or bronchus (windpipes) using a bronchoscope (see below) in order to sample nearby lymph nodes. This procedure, called transtracheal or transbronchial fine needle aspiration, is often used to take samples of lymph nodes around the windpipe and bronchi (the larger tubes that carry air to the lungs).

Bronchoscopy

For this exam, a lighted, flexible tube (bronchoscope) is passed through your mouth and down into the windpipe and bronchi. The mouth and throat are sprayed first with a numbing

medicine. You may also be given medicine through an intravenous (IV) line to make you feel relaxed.

Bronchoscopy can help find some tumors or blockages in the lungs. At the same time, small instruments can be passed down the bronchoscope to take biopsies (samples of tissue) or samples of lung secretions to be looked at under a microscope.

Endobronchial Ultrasound

Ultrasound is a type of imaging test that uses sound waves to create images of parts of your body. For this test, a small, microphone-like instrument called a transducer emits sound waves and picks up the echoes as they bounce off body tissues. The echoes are converted by a computer into a black and white image that is displayed on a computer screen.

For endobronchial ultrasound, a bronchoscope is fitted with an ultrasound transducer at its tip and is passed down into the windpipe. The transducer can be pointed in different directions to look at lymph nodes and other structures in the mediastinum (the area between the lungs). If suspicious areas (such as enlarged lymph nodes) are seen on the ultrasound, a hollow needle can be passed through the bronchoscope and guided by ultrasound into the abnormal structures to obtain a biopsy. The samples are then looked at under a microscope.

Endoscopic Esophageal Ultrasound (EUS)

This technique is similar to endobronchial ultrasound, except it involves using an endoscope (a lighted, flexible scope) that is passed down the throat and into the esophagus (the tube connecting the throat to the stomach), which lies just behind the windpipe. This is done with numbing medicine (local anesthesia) and light sedation.

The esophagus is close to some lymph nodes inside the chest to which lung cancer may spread. Ultrasound images taken from inside the esophagus can be helpful in finding large lymph nodes inside the chest that might contain lung cancer. If suspicious areas (such as enlarged lymph nodes) are seen on the ultrasound, a hollow needle can be passed through the endoscope to get biopsy samples of them. The samples are then looked at under a microscope.

Mediastinoscopy and Mediastinotomy

Both of these procedures allow the doctor to look more directly at and sample the structures in the mediastinum (the area between the lungs). They are done in an operating room while you are under general anesthesia (in a deep sleep). The main difference between a mediastinoscopy and a mediastinotomy is in the location and size of the incision.

For a *mediastinoscopy*, a small cut is made in the front of the neck above the breastbone (sternum) and a thin, hollow, lighted tube is inserted behind the sternum (breastbone). Special instruments can be passed through this tube to take tissue samples from the lymph nodes along the windpipe and the major bronchial tube areas. Looking at the samples under a microscope can show whether cancer cells are present.

Mediastinotomy also allows the doctor to look at and remove mediastinal lymph nodes while the patient is under general anesthesia. For mediastinotomy, the surgeon makes a slightly larger incision (usually about 2 inches long) between the second and third ribs next to the breast bone. This allows the surgeon to reach lymph nodes that are not reached by mediastinoscopy.

Thoracentesis

Thoracentesis is done to find out whether or not a build-up of fluid around the lungs (pleural effusion) is the result of cancer spreading to the lining of the lungs (pleura). The build-up might also be caused by a condition such as heart failure or an infection.

For this procedure, the skin is numbed and a needle is placed between the ribs to drain the fluid. The fluid is checked under a microscope to look for cancer cells. Chemical tests of the fluid are also sometimes useful in telling a malignant (cancerous) pleural effusion from a benign one.

If a malignant pleural effusion has been diagnosed, thoracentesis may be repeated to remove more fluid. Fluid build-up can prevent the lungs from filling with air, so thoracentesis can help the patient breathe better.

Thoracoscopy

This test can be done to determine if cancer has spread to the space between the lungs and the chest wall, as well as to the linings of these spaces. In *thoracoscopy*, a lighted tube with a video camera on the end is used to view the space between the lungs and the chest wall. Using this, the doctor can see potential cancer deposits on the lung or lining of the chest wall and remove small pieces of tissue to be looked at under the microscope. Thoracoscopy can also be used to sample lymph nodes and fluid.

Other Tests

Blood Tests

Blood tests are not used to diagnose lung cancer, but they are done to get a sense of a person's overall health.

Prior to surgery, blood tests can help tell if a person is healthy enough to have an operation.

A complete blood count (CBC) determines whether your blood has the correct number of various cell types. For example, it can show if you are anemic (have a low number of red blood cells), if you may have trouble with bleeding (due to a low number of blood platelets), or if you are at increased risk for infections (due to a low number of white blood cells). This test will be repeated regularly if you are treated with chemotherapy, because these drugs temporarily affect blood-forming cells of the bone marrow.

Blood chemistry tests can spot abnormalities in some of your organs. If cancer has spread to the liver and bones, it may cause certain chemical abnormalities in the blood. For example, spread to these areas may result in a higher than normal level of lactate dehydrogenase (LDH) in the blood.

Pulmonary Function Tests

Pulmonary function tests (PFTs) are often done after a lung cancer diagnosis to see how well your lungs are working. This is especially important if surgery might be an option in treating the cancer. Because surgical removal of part or all of lung results in lower lung capacity, it's important to know how well the lungs are working beforehand. These tests can give the surgeon an idea of how much lung can be removed or if surgery is a good option at all.

There are a few different types of PFTs, but they all basically involve having you breathe in and out through a tube that is connected to different machines.

How Is Non-Small Cell Lung Cancer Staged?

Staging is the process of finding out how far a cancer has spread. Your treatment and prognosis (the outlook for chances of survival) depend, to a large extent, on the cancer's stage.

Staging is based on the results of the physical exam, biopsies, and imaging tests (CT scan, chest x-ray, PET scan, etc.), which are described in the section, "How Is Non-Small Cell Lung Cancer Diagnosed?"

The TNM Staging System

The system used to describe the growth and spread of non-small cell lung cancer (NSCLC) is the American Joint Committee on Cancer (AJCC) **TNM** staging system. The TNM system describes 3 key pieces of information:

- **T** indicates the size of the main (primary) **tumor** and whether it has grown into nearby areas.

- **N** describes how much the cancer has spread to nearby (regional) lymph **nodes**. Lymph nodes are small bean-shaped collections of immune system cells that are important in fighting infections.

- **M** indicates whether the cancer has spread (**metastasized**) to other organs of the body. (The most common sites are the liver, bones, and brain.)

Numbers or letters appear after T, N, and M to provide more details about each of these factors. The numbers 0 through 4 indicate increasing severity. The letter X means "cannot be assessed because the information is not available."

T Categories for Non-small Cell Lung Cancer

TX: Main (primary) tumor can't be assessed, or cancer cells were seen on sputum cytology but no tumor can be found.

T0: No evidence of a primary tumor.

Tis: Cancer is found only in the layer of cells lining the air passages. It has not invaded into deeper lung tissues. This stage is also known as *carcinoma in situ*.

T1: The tumor is no larger than 3 centimeters (slightly less than 1¼ inches) across, has not reached the membranes that surround the lungs (visceral pleura), and does not affect the main branches of the bronchi.

T2: The tumor has 1 or more of the following features:

- It is larger than 3 centimeters (cm) across.
- It involves a main bronchus, but is not closer than 2 cm (about ¾ inch) to the carina (the point where the windpipe splits into the left and right main bronchi).
- It has grown into the membranes that surround the lungs (visceral pleura).
- The tumor partially clogs the airways, but this has not caused the entire lung to collapse or develop pneumonia.

T3: The tumor can be any size and has 1 or more of the following features:

- It has grown into the chest wall, the breathing muscle that separates the chest from the abdomen (diaphragm), the membranes surrounding the space between the two lungs (mediastinal pleura), or membranes of the sac surrounding the heart (parietal pericardium).

- It invades a main bronchus and is closer than 2 cm (about ¾ inch) to the carina, but it does not involve the carina itself.
- It has grown into the airways enough to cause an entire lung to collapse or to cause pneumonia in the entire lung.

T4: The cancer has 1 or more of the following features:

- A tumor of any size has grown into the space behind the chest bone and in front of the heart (mediastinum), the heart, the large blood vessels near the heart (such as the aorta), the windpipe, the esophagus (tube connecting the throat to the stomach), the backbone, or the carina.
- Two or more separate tumor nodules are present in the same lobe of a lung.
- There is a fluid containing cancer cells in the space surrounding the lung (a malignant pleural effusion).

N Categories for Non-small Cell Lung Cancer

NX: Nearby lymph nodes cannot be assessed.

N0: No spread to nearby lymph nodes.

N1: Spread to lymph nodes within the lung and/or around the area where the bronchus enters the lung (hilar lymph nodes). Affected lymph nodes are on the same side as the primary tumor(s).

N2: Spread to lymph nodes around the carina (the point where the windpipe splits into the left and right bronchi) or in the space behind the breastbone and in front of the heart (mediastinum). Affected lymph nodes are on the same side as the primary tumor.

N3: Spread to lymph nodes near the collarbone on either side, and/or spread to hilar or mediastinal lymph nodes on the side opposite the primary tumor.

M Categories for Non-small Cell Lung Cancer

M0: No spread to distant organs or areas. This includes other lobes of the lungs, lymph nodes further away than those mentioned in the N stages above, and other organs or tissues such as the liver, bones, or brain.

M1: The cancer has spread to 1 or more distant sites. This can be to another lobe of the lung, to distant lymph nodes, or to other organs.

Stage Grouping for Non-small Cell Lung Cancer

Once the T, N, and M categories have been assigned, this information is combined (stage grouping) to assign an overall stage of 0, I, II, III, or IV. Some stages are subdivided into A and B. The stages identify tumor types that have a similar prognosis and thus are treated in a similar way. Patients with lower stage numbers tend to have a better prognosis.

Occult Cancer

TX, N0, M0: Cancer cells are seen in a sample of sputum or other lung fluids, but the location of the cancer can't be determined.

Stage 0

Tis, N0, M0: The cancer is found only in the layer of cells lining the air passages. It has not invaded deeper into other lung tissues and has not spread to lymph nodes or distant sites.

Stage IA

T1, N0, M0: The cancer is no larger than 3 centimeters (cm) across, has not reached the membranes that surround the lungs, and does not affect the main branches of the bronchi. It has not spread to lymph nodes or distant sites.

Stage IB

T2, N0, M0: The cancer has 1 or more of the following features:

- The main tumor is larger than 3 cm across.
- The tumor involves a main bronchus, but is not within 2 cm of the carina.
- The tumor has grown into the visceral pleura (the membranes surrounding the lungs).
- The cancer is partially clogging the airways.

The cancer has not spread to lymph nodes or distant sites.

Stage IIA

T1, N1, M0: The cancer is no larger than 3 centimeters, has not grown into the membranes that surround the lungs, and does not affect the main branches of the bronchi. It has spread to lymph nodes within the lung and/or around the area where the bronchus enters the lung (hilar lymph nodes). It has not spread to distant sites.

Stage IIB

There are 2 combinations of categories that make up this stage.

T2, N1, M0: The cancer has 1 or more of the following features:

- The main tumor is larger than 3 cm across.
- The tumor involves a main bronchus, but is not within 2 cm of the carina.
- The tumor has grown into the visceral pleura (the membranes surrounding the lungs).
- The cancer is partially clogging the airways.

It has also spread to lymph nodes within the lung and/or around the area where the bronchus enters the lung (hilar lymph nodes). It has not spread to distant sites.

T3, N0, M0: The main tumor can be any size and has 1 or more of the following features:

- It has grown into the chest wall, the breathing muscle that separates the chest from the abdomen (diaphragm), the membranes surrounding the space between the two lungs (mediastinal pleura), or membranes of the sac surrounding the heart (parietal pericardium).
- It invades a main bronchus and is closer than 2 cm (about ¾ inch) to the carina, but it does not involve the carina itself.
- It has grown into the airways enough to cause an entire lung to collapse or to cause pneumonia in the entire lung.

The cancer has not spread to lymph nodes or distant sites.

Stage IIIA

There are 4 main combinations of categories that make up this stage.

T1, N2, M0: The cancer is no larger than 3 centimeters, has not grown into the membranes that surround the lungs, and does not affect the main branches of the bronchi. The cancer has spread to lymph nodes around the carina (the point where the windpipe splits into the left and right bronchi) or in the space behind the breastbone and in front of the heart (mediastinum). Affected lymph nodes are on the same side as the primary tumor. The cancer has not spread to distant sites.

T2, N2, M0: The cancer has 1 or more of the following features:

- The main tumor is larger than 3 cm across.
- The tumor involves a main bronchus, but is not within 2 cm of the carina.
- The tumor has grown into the visceral pleura (the membranes surrounding the lungs).

- The cancer is partially clogging the airways.

The cancer has also spread to lymph nodes around the carina (the point where the windpipe splits into the left and right bronchi) or in the space behind the breastbone and in front of the heart (mediastinum). Affected lymph nodes are on the same side as the primary tumor. The cancer has not spread to distant sites.

T3, N1, M0: The tumor can be any size and has 1 or more of the following features:

- It has grown into the chest wall, the breathing muscle that separates the chest from the abdomen (diaphragm), the membranes surrounding the space between the two lungs (mediastinal pleura), or membranes of the sac surrounding the heart (parietal pericardium).
- It invades a main bronchus and is closer than 2 cm (about ¾ inch) to the carina, but it does not involve the carina itself.
- It has grown into the airways enough to cause an entire lung to collapse or to cause pneumonia in the entire lung.

It has also spread to lymph nodes within the lung and/or around the area where the bronchus enters the lung (hilar lymph nodes). It has not spread to distant sites.

T3, N2, M0: The tumor can be any size and has 1 or more of the following features:

- It has grown into the chest wall, the breathing muscle that separates the chest from the abdomen (diaphragm), the membranes surrounding the space between the two lungs (mediastinal pleura), or membranes of the sac surrounding the heart (parietal pericardium).
- It invades a main bronchus and is closer than 2 cm (about ¾ inch) to the carina, but it does not involve the carina itself.
- It has grown into the airways enough to cause an entire lung to collapse or to cause pneumonia in the entire lung.

The cancer has also spread to lymph nodes around the carina (the point where the windpipe splits into the left and right bronchi) or in the space behind the breastbone and in front of the heart (mediastinum). Affected lymph nodes are on the same side as the primary tumor. The cancer has not spread to distant sites.

Stage IIIB

There are 2 combinations of categories that make up this stage.

Any T, N3, M0: The cancer can be of any size. It may or may not have grown into nearby structures or caused pneumonia or lung collapse. It has spread to lymph nodes near the

collarbone on either side, and/or has spread to hilar or mediastinal lymph nodes on the side opposite the primary tumor. The cancer has not spread to distant sites.

T4, any N, M0: The cancer has 1 or more of the following features:

- A tumor of any size has grown into the space behind the chest bone and in front of the heart (mediastinum), the heart, the large blood vessels near the heart (such as the aorta), the windpipe, the esophagus (tube connecting the throat to the stomach), the backbone, or the carina.
- Two or more separate tumor nodules are present in the same lobe of a lung.
- There is a fluid containing cancer cells in the space surrounding the lung (a malignant pleural effusion).

The cancer may or may not have spread to nearby lymph nodes. It has not spread to distant sites.

Stage IV

Any T, Any N, M1: The cancer can be any size and may or may not have grown into nearby structures or reached nearby lymph nodes. It has spread to distant sites.

Non-Small Cell Lung Cancer Survival Rates by Stage

The numbers below are relative survival rates calculated from the American College of Surgeons National Cancer Data Base, based on people who were diagnosed with non-small cell lung cancer in 1992 and 1993. There are some important points to note about these numbers:

- The *5-year survival rate* refers to the percentage of patients who live *at least* 5 years after being diagnosed. Many of these patients live much longer than 5 years after diagnosis. Five-year *relative* survival rates (such as the numbers below) don't include patients who die from other causes. They are considered to be a more accurate way to describe the outlook for patients with a particular type and stage of cancer.

- These numbers were derived from patients treated several years ago. While they are among the most current numbers we have available, improvements in treatment since then mean that the survival rates for people now being diagnosed with these cancers may be higher.

- While survival statistics can sometimes be useful as a general guide, they may not accurately represent any one person's prognosis. A number of other factors, including other tumor characteristics and a person's age and general health, can also affect

outlook. Your doctor is likely to be a good source as to whether these numbers may apply to you, as he or she is familiar with the aspects of your particular situation.

Stage	5-year Relative Survival Rate
I	47%
II	26%
III	8%
IV	2%

While these survival rates aren't broken down by substages, the rates will likely be higher than those above for the A subgroups and lower for the B subgroups.

How Is Non-Small Cell Lung Cancer 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.

The first part of this section describes the various types of treatments used for non-small cell lung cancer. This is followed by a description of the most common approaches used for these cancers based on the stage of the cancer.

Making Treatment Decisions

If you have non-small cell lung cancer (NSCLC), your treatment options may include surgery, radiation therapy, chemotherapy, targeted therapy, or some combination of these, depending on the stage of your cancer.

After the cancer is found and staged, your cancer care team will discuss your treatment options with you. It is important to take time and think about all of your possible choices. In choosing a treatment plan, one of the most important factors is the stage of the cancer. For this reason, it is very important that your doctor order all the tests needed to determine the

cancer's stage. Other factors to consider include your overall health, the likely side effects of the treatment, and the probability of curing the disease, extending life, or relieving symptoms. One thing to remember is that age alone should not be a barrier to treatment. Older people can benefit from treatment as much as younger people, as long as their general health is good.

In considering your treatment options it is often a good idea to seek a second opinion, if possible. This may provide you with more information and help you feel more confident about the treatment plan you have chosen. Your doctor should not mind your doing this. In fact, some insurance companies require you to get a second opinion. If your first doctor has done tests, the results can be sent to the second doctor so that you will not have to have them done again.

Surgery

Depending on the type and stage of a lung cancer, surgery may be used to remove the cancer along with some surrounding lung tissue. Surgery is usually recommended (often along with other treatments) for early stage lung cancers. If surgery can be done, it provides the best chance to cure NSCLC.

If your doctor thinks the lung cancer can be treated with surgery, pulmonary function tests will be done beforehand to determine whether you will have enough healthy lung tissue remaining after surgery.

Several different operations can be used to treat (and possibly cure) non-small cell lung cancer:

- *pneumonectomy* -- the entire lung is removed in this surgery.
- *lobectomy* -- a section (lobe) of the lung is removed in this surgery.
- *segmentectomy* or *wedge resection* -- part of a lobe is removed in this surgery.

With any of these operations, lymph nodes are also removed to look for possible spread of the cancer.

These operations require general anesthesia (where you are in a deep sleep) and a surgical incision between the ribs in the chest (thoracotomy). You will generally need to spend 5 to 7 days in the hospital after the surgery.

Recently, some doctors have begun to use a less invasive procedure for treating early stage lung cancer called *video-assisted thoracic surgery (VATS).* During this operation, a thin hollow tube with a tiny video camera on the end is placed through a small hole in the chest to help the surgeon see the tumor. One or two other small holes are created in the skin, and long instruments passed though these holes are used to remove the tumor. Because only small incisions are needed, there is a little less pain after the surgery. Another advantage of this

surgery is a shorter hospital stay – usually around 5 days. Most experts recommend that only early stage tumors smaller than 3 to 4 centimeters (about 1 1/2 inches) be treated this way. The cure rate after this surgery seems to be the same as with older techniques. It is important, though, that the surgeon performing this procedure be experienced since it requires more technical skill than the standard surgery.

If the lung cancer has spread to the brain and there is only one tumor, you may benefit from removal of the brain metastasis. This is done by surgery through a hole in the skull (craniotomy). It should only be done if the tumor can be removed without damage to vital areas of the brain that control movement, sensation, and speech and only if the lung tumor can also be completely removed.

Possible complications of surgery include excessive bleeding, wound infections, and pneumonia. Because the surgeon must spread ribs to get to the lung, the incision will hurt for some time after surgery. Your activity will be limited for at least a month or two.

If your lungs are in good condition (other than the presence of the cancer) you can usually return to normal activities after a lobe or even an entire lung has been removed. If you also have non-cancerous diseases such as emphysema or chronic bronchitis (which are common among heavy smokers), you may become short of breath with activities after surgery.

Surgery to relieve symptoms of NSCLC: If you can't have major surgery because of reduced lung function or other serious medical problems, or if the cancer is widespread, other types of surgery may be used to relieve some symptoms. For example, laser surgery can be used to relieve blockage of airways that may be causing pneumonia or shortness of breath. Other techniques, such as photodynamic therapy (described later in the document) may also be used.

Sometimes fluid can build up in the chest cavity (outside of the lungs) and interfere with breathing. To remove the fluid and keep it from coming back, doctors sometimes perform a procedure called *pleurodesis*. A small tube is placed in the chest, the fluid is removed, and either talc or a drug such as doxycycline or a chemotherapy drug is instilled into the chest cavity. This causes the linings of the lung (visceral pleura) and chest wall (parietal pleural) to stick together, sealing the space and preventing further fluid buildup. The tube is generally left in for a day or two to drain any new fluid that might accumulate.

For more general information about surgery, please see the separate American Cancer Society document, *Surgery*.

Radiation Therapy

Radiation therapy uses high-energy rays (such as x-rays) or particles to kill cancer cells. There are 2 main types of radiation therapy -- *external beam radiation therapy* and *brachytherapy* (internal radiation therapy).

External Beam Radiation Therapy

External beam radiation therapy (EBRT) uses radiation delivered from outside the body that is focused on the cancer. This is the type of radiation therapy most often used to treat a primary lung cancer or its metastases to other organs.

Before your treatments start, the radiation team will take careful measurements to determine the correct angles for aiming the radiation beams and the proper dose of radiation. Radiation therapy is much like getting an x-ray, but the radiation is more intense. The procedure itself is painless. Each treatment lasts only a few minutes, although the setup time -- getting you into place for treatment -- usually takes longer. Most often, radiation treatments are given 5 days a week for 5 to 8 weeks.

Standard (conventional) EBRT is used much less often than in the past. Newer techniques allow doctors to be more accurate in treating lung cancers while reducing the radiation exposure to nearby healthy tissues. These techniques may offer better chances of increasing the success rate and reducing side effects.

Three-dimensional conformal radiation therapy (3D-CRT): 3D-CRT uses special computers to precisely map the location of the tumor(s). Radiation beams are shaped and aimed at the tumor(s) from several directions, which makes it less likely to damage normal tissues. Most doctors now recommend using 3D-CRT when it is available.

Intensity modulated radiation therapy (IMRT): IMRT is an advanced form of 3D therapy. It uses a computer-driven machine that moves around the patient as it delivers radiation. Along with shaping the beams and aiming them at the tumor from several angles, the intensity (strength) of the beams can be adjusted to minimize the dose reaching the most sensitive normal tissues. This technique is used most often if tumors are near important structures such as the spinal cord. Many major hospitals and cancer centers are now able to provide IMRT.

Stereotactic radiation therapy: A newer form of treatment, known as stereotactic body radiation therapy (SBRT), is sometimes used to treat very early stage lung cancers. It is described in more detail in the section, "What's New in Non-Small Cell Lung Cancer Research and Treatment?"

Another type of stereotactic radiation therapy called the Gamma Knife® can sometimes be used instead of surgery for single tumors that have spread to the brain. In this procedure, multiple beams of high-dose radiation are focused on the tumor from different angles over a few minutes to hours. The head is kept in the same position by placing it in a rigid frame.

Brachytherapy (Internal Radiation Therapy)

Brachytherapy is used most often to shrink tumors to relieve symptoms caused by the cancer, although in some cases it may be part of a larger treatment regimen trying to cure the cancer. It involves placing a small source of radioactive material (often in the form of pellets) directly into the cancer or into the airway next to the cancer. This is usually done through a bronchoscope, although it may also be done during surgery. The radiation travels only a short distance, limiting the effects on surrounding healthy tissues. The radiation source is usually removed after a short time; less often, small radioactive "seeds" are left in place permanently.

When Is Radiation Therapy Used?

External beam radiation therapy is sometimes used as the main treatment of lung cancer (sometimes together with chemotherapy), especially if the lung tumor cannot be removed by surgery because it is close to large blood vessels or the person's general health is too poor. Brachytherapy is most often used to help relieve blockage of large airways by cancer.

After surgery, radiation therapy can be used (alone or along with chemotherapy) to kill very small deposits of cancer that cannot be seen and removed during surgery.

Radiation therapy can also be used to relieve (palliate) symptoms of lung cancer such as pain, bleeding, trouble swallowing, cough, and problems caused by brain metastases.

Possible Side Effects

Side effects of external radiation therapy might include mild skin problems, nausea, vomiting, and fatigue. Often these go away after a short while. Radiation might also make the side effects of chemotherapy worse. Chest radiation therapy may damage your lungs and cause problems breathing and shortness of breath. Your esophagus, which is located in the middle of your chest, may be exposed to radiation, which could cause trouble swallowing during treatment. This usually improves shortly after treatment is over.

Radiation therapy to large areas of the brain can sometimes cause changes in brain function. Some people notice memory loss, headache, trouble thinking, or reduced sexual desire. Usually these symptoms are minor compared to those caused by a brain tumor, but they can reduce your quality of life. Side effects of radiation therapy to the brain usually become most serious 1or 2 years after treatment.

For more general information about radiation therapy, please see the separate American Cancer Society document, *Understanding Radiation Therapy: A Guide for Patients and Families.*

Other Local Treatments

At times, treatments other than surgery or radiation therapy may be used to destroy lung cancer cells at a specific location.

Radiofrequency Ablation (RFA)

This technique is being studied for small lung tumors that are near the outer edge the lungs, especially in people who can't have or don't want surgery. It uses high-energy radio waves to heat the tumor. A thin, needle-like probe is placed through the skin and advanced until the end is in the tumor. Placement of the probe is guided by ultrasound or CT scans. Once it is in place, an electric current is passed through the probe, which heats the tumor and destroys the cancer cells. RFA is usually done as an outpatient procedure, using local anesthesia (numbing medicine) where the probe is inserted. You may be given medicine to help you relax as well.

Major complications are uncommon, but they can include the partial collapse of a lung (which often resolves on its own) or bleeding into the lung.

Photodynamic Therapy (PDT)

Photodynamic therapy is sometimes used to treat smaller lung cancers near airways when other treatments aren't appropriate, or to help open up airways blocked by tumors to help people breathe better.

For this technique, a light-activated drug called porfimer sodium (Photofrin) is injected into a vein. Over the next couple of days, the drug is more likely to collect in cancer cells than in normal cells. A bronchoscope is passed down the throat and into the lung. A special red light on the end of the bronchoscope is aimed at the tumor, causing the cells to die. This may be done with either local anesthesia (where the throat is numbed) or general anesthesia (where you are in a deep sleep). The dead cells are then removed a few days later during a bronchoscopy. This process can be repeated if needed.

Some of this drug also collects in normal cells in the body, such as skin and eye cells. This can make you very sensitive to sunlight or strong indoor lights. Too much exposure can cause serious skin reactions. For this reason, doctors recommend staying out of any strong light for 4 to 6 weeks after the injection.

For more information, please see the separate American Cancer Society document, *Photodynamic Therapy*.

Chemotherapy

Chemotherapy is treatment with anti-cancer drugs injected into a vein or taken by mouth. These drugs enter the bloodstream and go throughout the body, making this treatment useful for cancer that has spread (metastasized) to distant organs. Depending on the type and stage of lung cancer, chemotherapy may be given as the main (primary) treatment or as an addition (adjuvant) to surgery.

Doctors give chemotherapy in cycles, with each period of treatment followed by a rest period to allow the body time to recover. Chemotherapy cycles generally last about 3 to 4 weeks, and initial treatment typically involves 4 to 6 cycles. Chemotherapy is not recommended for patients in poor health. Advanced age is not a barrier, as long as the patient is not in poor health.

Most often, initial chemotherapy for lung cancer uses a combination of 2 drugs. Studies have shown that 2 drugs seem to be as good as 3 and are likely to cause fewer side effects. The drugs most frequently used for initial chemotherapy for NSCLC are:

- cisplatin
- carboplatin
- paclitaxel
- docetaxel
- gemcitabine
- vinorelbine
- irinotecan
- etoposide
- vinblastine

The most common combinations include either cisplatin or carboplatin plus one other drug, although some studies have found that using combinations with less severe side effects, such as gemcitabine with vinorelbine or paclitaxel, may be just as effective for many patients.

For people whose cancers meet certain criteria, a targeted therapy known as bevacizumab (Avastin) may be added to initial treatment as well (see "Targeted Therapies" below).

Single-drug chemotherapy is sometimes used for people who might not tolerate combination chemotherapy well, such as those in poor overall health.

If the initial chemotherapy treatment is no longer working, second-line treatment usually consists of a single drug such as docetaxel or pemetrexed. Another option may be the targeted therapy erlotinib (see "Targeted Therapies" below).

Again, advanced age is no barrier to receiving these drugs as long as the person is in good general health.

Possible Side Effects

Chemotherapy drugs work by attacking cells that are dividing quickly, which is why they work against cancer 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 of chemotherapy depend on the type and dose of drugs given and the length of time they are taken. These side effects can include:

- hair loss
- mouth sores
- loss of appetite
- nausea and vomiting
- increased chance of infections (due to low white blood cell counts)
- easy bruising or bleeding (due to low blood platelet counts)
- fatigue (due to low red blood cell counts)

These side effects are usually short-term and go away after treatment is finished. There are often ways to lessen these side effects. For example, there are very good drugs that can be given to help prevent or reduce nausea and vomiting.

Some drugs such as cisplatin, vinorelbine, docetaxel, or paclitaxel can damage nerves. You might feel numbness or tingling, particularly in your fingers and toes, and sometimes your arms and legs might feel weak. (This is called peripheral neuropathy.) You should report this, as well as any other side effects or changes you notice while getting chemotherapy, to your medical team so that they can be treated promptly. In some cases, the doses of the chemotherapy drugs may need to be reduced or treatment may need to be delayed or stopped to prevent the effects from getting worse.

For more general information about chemotherapy, please see the separate American Cancer Society document, *Understanding Chemotherapy: A Guide for Patients and Families*.

Targeted Therapies

As researchers have learned more about the gene changes in cells that cause cancer, they have been able develop newer drugs that specifically target these changes. These targeted drugs work differently than standard chemotherapy drugs. They often have different (and less severe) side effects. At this time, they are most often used either along with chemotherapy or if chemotherapy is no longer working.

Drugs That Target Tumor Blood Vessel Growth (Angiogenesis)

For cancers to grow, they must form new blood vessels to keep them nourished. This process is called angiogenesis. Some newer targeted drugs block this new vessel growth.

Bevacizumab (Avastin) is a type of drug known as a monoclonal antibody (a manmade version of a specific immune system protein) that targets vascular endothelial growth factor (VEGF). It has been shown to prolong survival of patients with advanced lung cancer when it is added to standard chemotherapy regimens as part of first-line treatment.

Bevacizumab is given by infusion into a vein every 2 to 3 weeks.

The possible side effects of this drug are different from those of chemotherapy drugs. Some of these effects can be serious. It can cause bleeding, which limits its use to some extent. It is not used in patients who are coughing up blood, who have cancer that has spread to the brain, or who are on "blood thinners" such as aspirin or warfarin (Coumadin). It also cannot be used in patients with squamous cell cancer, because it may lead to bleeding from this type of lung cancer.

Other possible effects include high blood pressure, loss of appetite, delayed wound healing, and an increased risk of blood clots.

Drugs That Target EGFR

Epidermal growth factor receptor (EGFR) is a protein found on the surface of cells. It normally receives signals telling the cells to grow and divide. Some lung cancer cells have too many copies of EGFR, which help them grow faster.

Erlotinib (Tarceva) is a drug that blocks EGFR from signaling the cell to grow. It has been shown to help keep some lung tumors under control, especially in women and in people who never smoked. It is most often used for advanced lung cancers if initial treatment with chemotherapy is no longer working.

This drug is taken by mouth. The most common side effects of erlotinib include an acne-like rash on the face and chest, diarrhea, loss of appetite, and feeling tired.

Clinical Trials

You 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 deciding 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 one way to get state-of-the art cancer care. Still, they are not right for everyone.

Here we will give you a brief review of clinical trials. Talking to your health care team, your family, and your friends can help you make the best treatment choice for you.

What Are Clinical Trials?

Clinical trials are carefully controlled research studies that are done with patients. These studies test whether a new treatment is safe and how well it works in patients, or they may test new ways to diagnose or prevent a disease. Clinical trials have led to many advances in cancer prevention, diagnosis, and treatment.

The Purpose of Clinical Trials

Clinical trials are done to get a closer look at promising new treatments or procedures in patients. A clinical trial is only done when there is good reason to believe that the treatment, test, or procedure being studied may be better than the one used now. Treatments used in clinical trials are often found to have real benefits and may go on to become tomorrow's standard treatment.

Clinical trials can focus on many things, such as:

- new uses of drugs that are already approved by the US Food and Drug Administration (FDA)
- new drugs that have not yet been approved by the FDA
- non-drug treatments (such as radiation therapy)
- medical procedures (such as types of surgery)
- herbs and vitamins
- tools to improve the ways medicines or diagnostic tests are used
- medicines or procedures to relieve symptoms or improve comfort
- combinations of treatments and procedures

Researchers conduct studies of new treatments to try to answer the following questions:

- Is the treatment helpful?
- What's the best way to give it?
- Does it work better than other treatments already available?
- What side effects does the treatment cause?
- Are there more or fewer side effects than the standard treatment used now?
- Do the benefits outweigh the side effects?
- In which patients is the treatment most likely to be helpful?

Phases of Clinical Trials

There are 4 phases of clinical trials, which are numbered I, II, III, and IV. We will use the example of testing a new cancer treatment drug to look at what each phase is like.

Phase I clinical trials: The purpose of a phase I study is to find the best way to give a new treatment safely to patients. The cancer care team closely watches patients for any harmful side effects.

For phase I studies, the drug has already been tested in lab and animal studies, but the side effects in patients are not fully known. Doctors start by giving very low doses of the drug to the first patients and increase the doses for later groups of patients until side effects appear or the desired effect is seen. Doctors are hoping to help patients, but the main purpose of a phase I trial is to test the safety of the drug.

Phase I clinical trials are often done in small groups of people with different cancers that have not responded to standard treatment or that keep coming back (recurring) after treatment. If a drug is found to be reasonably safe in phase I studies, it can be tested in a phase II clinical trial.

Phase II clinical trials: These studies are designed to see if the drug works. Patients are given the best dose as determined from phase I studies. They are closely watched for an effect on the cancer. The cancer care team also looks for side effects.

Phase II trials are often done in larger groups of patients with a specific cancer type that has not responded to standard treatment. If a drug is found to be effective in phase II studies, it can be tested in a phase III clinical trial.

Phase III clinical trials: Phase III studies involve large numbers of patients -- most often those who have just been diagnosed with a specific type of cancer. Phase III clinical trials may enroll thousands of patients.

Often, these studies are randomized. This means that patients are randomly put in one of two (or more) groups. One group (called the control group) gets the standard, most accepted treatment. Another group (or more than one group) will get the new treatment being studied. All patients in phase III studies are closely watched. The study will be stopped early if the side effects of the new treatment are too severe or if one group has much better results than the others.

Phase III clinical trials are usually needed before the FDA will approve a treatment for use by the general public.

Phase IV clinical trials: Once a drug has been approved by the FDA and is available for all patients, it is still studied in other clinical trials (sometimes referred to as phase IV studies). This way more can be learned about short-term and long-term side effects and safety as the drug is used in larger numbers of patients with many types of diseases. Doctors can also learn

more about how well the drug works, and if it might be helpful when used in other ways (such as in combination with other treatments).

What It Will Be Like to Be in a Clinical Trial

If you are in a clinical trial, you will have a team of experts taking care of you and watching your progress very carefully. Depending on the phase of the clinical trial, you may receive more attention (such as having more doctor visits and lab tests) than you would if you were treated outside of a clinical trial. Clinical trials are specially designed to pay close attention to you.

However, there are some risks. No one involved in the study knows in advance whether the treatment will work or exactly what side effects will occur. That is what the study is designed to find out. While most side effects go away in time, some may be long-lasting or even life threatening. Keep in mind, though, that even standard treatments have side effects. Depending on many factors, you may decide to enter (enroll in) a clinical trial.

Deciding to Enter a Clinical Trial

If you would like to take part in a clinical trial, you should begin by asking your doctor if your clinic or hospital conducts clinical trials. There are requirements you must meet to take part in any clinical trial. But whether or not you enter (enroll in) a clinical trial is completely up to you.

Your doctors and nurses will explain the study to you in detail. They will go over the possible risks and benefits and give you a form to read and sign. The form says that you understand the clinical trial and want to take part in it. This process is known as giving your informed consent. Even after reading and signing the form and after the clinical trial begins, you are free to leave the study at any time, for any reason. Taking part in a clinical trial does not keep you from getting any other medical care you may need.

To find out more about clinical trials, talk to your cancer care team. Here are some questions you might ask:

- Is there a clinical trial that I could take part in?
- What is the purpose of the study?
- What kinds of tests and treatments does the study involve?
- What does this treatment do? Has it been used before?
- Will I know which treatment I receive?
- What is likely to happen in my case with, or without, this new treatment?
- What are my other choices and their pros and cons?
- How could the study affect my daily life?
- What side effects can I expect from the study? Can the side effects be controlled?

- Will I have to stay in the hospital? If so, how often and for how long?
- Will the study cost me anything? Will any of the treatment be free?
- If I am harmed as a result of the research, what treatment would I be entitled to?
- What type of long-term follow-up care is part of the study?
- Has the treatment been used to treat other types of cancers?

How Can I Find Out More About Clinical Trials That Might Be Right for Me?

The American Cancer Society offers a clinical trials matching service for patients, their family, and friends. You can reach this service at 1-800-303-5691 or on our Web site at http://clinicaltrials.cancer.org.

Based on the information you give about your cancer type, stage, and previous treatments, this service can put together a list of clinical trials that match your medical needs. The service will also ask where you live and whether you are willing to travel so that it can look for a treatment center that you can get to.

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.

For even more information on clinical trials, the American Cancer Society has a document called *Clinical Trials: What You Need to Know.* You can read this on the Web site, www.cancer.org, or have it sent to you by calling 1-800-ACS-2345.

Complementary and Alternative Therapies

When you have cancer you are likely to hear about ways to treat your cancer or relieve symptoms that are different from mainstream (standard) medical treatment. These methods can include vitamins, herbs, and special diets, or methods such as acupuncture or massage—among many others. You may have a lot of questions about these treatments. Here are some you may have thought of already:

- How do I know if a non-standard treatment is safe?
- How do I know if it works?
- Should I try one or more of these treatments?
- What does my doctor know/think about these methods? Should I tell the doctor that I'm thinking about trying them?
- Will these treatments cause a problem with my standard medical treatment?
- What is the difference between "complementary" and "alternative" methods?
- Where can I find out more about these treatments?

The Terms Can Be Confusing

Not everyone uses these terms the same way, so it can be confusing. The American Cancer Society uses *complementary* to refer to medicines or methods that are used *along with* your regular medical care. *Alternative* medicine is a treatment used *instead of* standard medical treatment.

Complementary methods: Complementary treatment methods, for the most part, are not presented as cures for cancer. Most often they are used to help you feel better. Some methods that can be used in a complementary way are meditation to reduce stress, acupuncture to relieve pain or peppermint tea to relieve nausea. There are many others. Some of these methods are known to help, while others have not been tested. Some have been proven not be helpful. A few have even been found harmful. However, some of these methods may add to your comfort and well-being.

There are many complementary methods that you can safely use right along with your medical treatment to help relieve symptoms or side effects, to ease pain, and to help you enjoy life more. For example, some people find methods such as aromatherapy, massage therapy, meditation, or yoga to be useful.

Alternative treatments: Alternative treatments are those that are used instead of standard medical care. These treatments have not been proven safe and effective in clinical trials. Some of these methods may even be dangerous and some have life-threatening side effects. The biggest danger in most cases is that you may lose the chance to benefit from standard treatment. Delays or interruptions in your standard medical treatment may give the cancer more time to grow.

Deciding What to Do

It is easy to see why people with cancer may consider alternative methods. You want to do all you can to fight the cancer. Sometimes mainstream treatments such as chemotherapy can be hard to take, or they may no longer be working.

Sometimes people suggest that their method can cure your cancer without having serious side effects, and it's normal to want to believe them. But the truth is that most non-standard methods of treatment have not been tested and proven to be effective for treating cancer.

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

- Talk to your doctor or nurse about any method you are thinking about using.
- Check the list of "red flags" below.
- Contact the American Cancer Society at 1-800-ACS-2345 to learn more about complementary and alternative methods in general and to learn more about the specific methods you are thinking about.

Red Flags

You can use the questions below to spot treatments or methods to avoid. A "yes" answer to any one of these questions should raise a "red flag."

- Does the treatment promise a cure for all or most cancers?
- Are you told not to use standard medical treatment?
- Is the treatment or drug a "secret" that only certain people can give?
- Does the treatment require you to travel to another country?
- Do the promoters attack the medical or scientific community?

The Decision Is Yours

Decisions about how to treat or manage your cancer are always yours to make. If you are thinking about using a complementary or alternative method, be sure to learn about the method and talk to your doctor about it. With reliable 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.

Treatment Choices by Stage for Non-Small Cell Lung Cancer

If you smoke, one of the most important things you can do to be ready for treatment is to quit. Studies have shown that patients who stop smoking after a diagnosis of lung cancer have better outcomes than those who don't.

Occult Cancer

For these cancers, malignant cells are seen on sputum cytology but no obvious tumor can be found with bronchoscopy or imaging tests. They are usually early stage cancers. Bronchoscopy is usually repeated about every 3 months to look for a tumor. If a tumor is found, treatment will depend on the stage.

Stage 0

Because stage 0 non-small cell lung cancer (NSCLC) is limited to the lining layer of air passages and has not invaded deeper into the lung tissue or other areas, it is curable by surgery alone. No chemotherapy or radiation therapy is needed.

If you are healthy enough for surgery, you can usually be treated by segmentectomy or wedge resection (removal of defined segments or small wedges). Cancers in some locations (such as where the windpipe divides into the left and right main bronchi) may be hard to remove completely by surgery without removing a lobe or even an entire lung.

In some cases, photodynamic therapy, laser surgery, or brachytherapy may be useful alternatives to surgery for stage 0 cancers. If you are truly stage 0, these treatments will probably cure you.

Stage I

If you have stage I NSCLC your treatment may be only surgery -- removal of the tumor either by taking out one lung lobe (lobectomy) or taking out part of a lung by doing a segmentectomy or wedge resection. If none of the lymph nodes between the lungs have been removed prior to surgery, some of them may be removed at this time to check them for cancer cells.

Segmentectomy or wedge resection is recommended only for treating the smallest stage I cancers and for patients with other medical conditions that make removing the entire lobe dangerous. This is the stage that is most suited for video-assisted thoracic surgery (VATS). Still, most surgeons believe it is better to perform a lobectomy if the patient can tolerate it, as it offers the best chance for cure.

Clinical trials are now looking at molecular changes that may indicate increased risk for recurrence after surgery and justify the use of adjuvant chemotherapy.

After surgery, chemotherapy and/or radiation therapy may be recommended if the pathologists report that there were cancer cells at the edge of the surgery specimen. This means that some cancer may have been left behind. Another approach would be to repeat the operation to ensure that all the cancer has been removed. (This might be followed by chemotherapy as well.)

If you have serious medical problems, you may receive only radiation therapy as your main treatment.

Stage II

People who have stage II NSCLC and are healthy enough for surgery usually have the cancer removed by lobectomy. Segmentectomy may sometimes be performed. Sometimes removing the whole lung (pneumonectomy) is needed.

Any lymph nodes likely to have cancer in them are also removed. The type of lymph node involvement and whether or not cancer cells are found at the edges of the removed tissues are important factors when planning the next step of treatment.

After surgery, chemotherapy will be used to try to destroy any cancer cells left behind. Radiation therapy may also be used, especially if cancer cells were found at the edge of the tissue removed by surgery. Further surgery could also be an option.

If you have serious medical problems, you may receive only radiation therapy as your main treatment.

Stage IIIA

Treatment for stage IIIA NSCLC may include radiation therapy, chemotherapy, surgery or some combination of these. For this reason, planning treatment for stage IIIA NSCLC will often require input from a medical oncologist, radiation oncologist, and surgeon. Treatment options will depend on the size of the tumor, where it is located in your lung, and which lymph nodes it has spread to.

For patients who can tolerate it, treatment usually starts with chemotherapy, with or without radiation therapy. Surgery may be an option at this point if the doctor thinks any remaining cancer can be removed and the patient is healthy enough. (In selected cases, surgery may be the first treatment.) This is often followed by chemotherapy, and possibly radiation therapy if it hasn't been given before.

All of this depends on a person's overall health and how well they are tolerating treatment. For people who can't tolerate chemotherapy or surgery, radiation therapy is usually the treatment of choice.

Stage IIIB

Stage IIIB NSCLC has usually spread too widely to be completely removed by surgery. If you are in fairly good health you may be helped by chemotherapy and radiation therapy. In some cases where all of the cancer may be removable (such as certain T4N0 tumors), you may be able to have surgery. Chemotherapy (with or without radiation therapy) is often given first. After surgery, chemotherapy and radiation (if not given before surgery) is recommended.

For stage IIIB cancers that have caused a malignant pleural effusion (fluid in the space around the lungs), treatment is generally the same as for stage IV disease (see below). The fluid may be drained and pleurodesis may be done to help prevent it from coming back.

Again, treatment depends on a person's overall health and how well they are tolerating it. For people who can't tolerate chemotherapy or surgery, radiation therapy is usually the treatment of choice.

Because treatment is unlikely to cure these cancers, taking part in a clinical trial of newer treatments may be a good option. Several clinical trials are in progress to determine the best treatment for people with this stage of lung cancer.

Stage IV

Stage IV NSCLC is widespread when it is diagnosed. Because these cancers have spread to distant organs, they are very hard to cure. Treatment options depend on the site of the distant spread and the number of tumors. If you are in otherwise good health, treatments such as surgery, chemotherapy, and radiation therapy may help you live longer and make you feel better by relieving symptoms, even though they aren't likely to cure you. In any case, if you are going to receive treatment for advanced NSCLC, the goals of treatment should be clear to you before you start.

Cancer that has spread widely throughout the body is treated with chemotherapy, as long as the person is healthy enough to tolerate it. People who are not at high risk for bleeding (that is, they do not have squamous cell NSCLC, do not have cancer spread to the brain, have not coughed up blood, and are not taking "blood thinning" medicine) may also get the targeted therapy bevacizumab (Avastin).

Cancer that is limited in the lungs and has only spread to 1 or 2 other areas (such as the brain, adrenal gland, or the other lung) can sometimes be treated with surgery or radiation therapy. For example, a single tumor in the brain may be treated with surgery or stereotactic radiation (such as the Gamma Knife), followed by radiation to the whole brain.

As with other stages, treatment depends on a person's overall health and how well they are tolerating it. For example, some people not in good health might get only one chemotherapy drug instead of two. For people who can't tolerate chemotherapy or surgery, radiation therapy is usually the treatment of choice.

Because treatment is unlikely to cure these cancers, taking part in a clinical trial of newer treatments may be a good option.

Cancer That Progresses or Recurs After Treatment

If cancer continues to grow during treatment or comes back, further treatment will depend on the extent of the cancer, what treatments have been used, and a person's health and desire for further treatment. Again, it is important to understand the goal of any further treatment -- whether it is to try to cure the cancer or to help relieve symptoms.

If cancer continues to grow during initial treatment such as radiation therapy, chemotherapy may be tried. If a cancer continues to grow during combination chemotherapy, second line treatment most often consists of a single chemotherapy drug or the targeted therapy erlotinib (Tarceva).

Smaller cancers that recur locally in the lungs can sometimes be retreated with surgery or radiation therapy (if it hasn't been used before). Cancers that recur in the lymph nodes between the lungs are usually treated with chemotherapy, possibly along with radiation if it hasn't been used before. For cancers that return at distant sites, chemotherapy is often the treatment of choice. As with stage IV cancers, surgery or radiation may also be tried if the recurrence is limited to 1 or 2 specific areas such as the brain or adrenal gland.

At some point, it may become clear that standard treatments are no longer controlling the cancer. If you want to continue anti-cancer treatment, you might think about taking part in a clinical trial of newer lung cancer treatments. While these are not always the best option for every person, they may benefit you as well as future patients.

Even if you have incurable lung cancer you should be as free of symptoms as possible. If curative treatment is not an option, treatment aimed at specific sites can often relieve symptoms and may even slow the spread of the disease. Symptoms such as shortness of breath or coughing up blood caused by cancer in the lung airways can often be treated effectively with radiation therapy, brachytherapy, laser therapy, photodynamic therapy, or even surgery if needed. Radiation therapy can be used to help control cancer spread in the brain or relieve pain if cancer has spread to the bones.

Many people with lung cancer are concerned about pain. As the cancer grows near certain nerves it can sometimes cause pain, but this can almost always be treated effectively with pain medicines. Sometimes radiation therapy will help as well. It is important that you talk to your doctor and take advantage of these treatments.

Deciding on the right time to stop treatment aimed at curing the cancer and focus on care that relieves symptoms is never easy. Good communication with doctors, nurses, family, friends, and clergy can often help people facing this situation.

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 American Cancer Society collaborates with the NCCN to produce a version of the lung cancer treatment guidelines written specifically for patients and their families. This less-technical version is available on both the NCCN Web site (www.nccn.org) and the ACS Web site (www.cancer.org). A print version can also be requested from the ACS at 1-800-ACS-2345.

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 www.cancer.gov.

What Should You Ask Your Doctor About Non-Small Cell Lung Cancer?

It is important for you to have honest, open discussions with your cancer care team. They want to answer all of your questions, no matter how minor you might think they are. Some questions to consider:

- What kind of lung cancer do I have?
- Has my cancer spread beyond the primary site?
- What is the stage of my cancer, and what does that mean in my case?
- What should I do to be ready for treatment?
- What treatment choices do I have?
- What do you recommend and why?
- What are the chances my cancer can be cured with these options?
- What risks or side effects are there to the treatments you suggest?
- What type of follow-up will I need after treatment?
- What are the chances of recurrence of my cancer with these treatment plans? What would we do if that happens?

Along with these sample questions, be sure to write down some of your own. For instance, you might want more information about recovery times so you can plan your work schedule. Or you may want to ask about second opinions or about clinical trials for which you may qualify.

What Happens After Treatment for Non-Small Cell Lung Cancer?

Completing treatment can be both stressful and exciting. You will be relieved to finish treatment, yet it is hard not to worry about cancer coming back. (When cancer returns, it is called recurrence.) This is a very common concern among those who have had cancer.

It may take a while before your confidence in your own recovery begins to feel real and your fears are somewhat relieved. You can learn more about what to look for and how to learn to live with the possibility of cancer coming back in the American Cancer Society document, *Living With Uncertainty: The Fear of Cancer Recurrence*, available at 1-800-ACS-2345.

Follow-up Care

After your treatment is over, it is very important to keep all follow-up appointments. During these visits, your doctors will ask about symptoms, do physical exams, and order blood tests or imaging studies such as CT scans or x-rays.

Most doctors recommend follow-up visits and CT scans every 4 to 6 months for the first 2 years after treatment, and yearly visits and CT scans after this.

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.

Almost any cancer treatment can have side effects. Some may last for a few weeks to several months, but others can be permanent. Don't hesitate to tell your cancer care team about any symptoms or side effects that bother you so they can help you manage them.

Should your cancer come back the American Cancer Society document, *When Your Cancer Comes Back: Cancer Recurrence* gives you information on how to manage and cope with this phase of your treatment. You can get this document by calling 1-800-ACS-2345.

Keep Medical Insurance and Copies of Your Medical Records

At some point after your cancer diagnosis and treatment, you may find yourself in the office of a new doctor. Your original doctor may have moved or retired, or you may have moved or changed doctors for some reason. It is important that you be able to give your new doctor the exact details of your diagnosis and treatment. Make sure you have the following information handy:

- a copy of your pathology report from any biopsy or surgery
- if you had surgery, a copy of your operative report
- if you had radiation, a final summary of the dose and field
- if you were hospitalized, a copy of the discharge summary that every doctor must prepare when patients are sent home from the hospital
- finally, since some drugs can have long-term side effects, a list of your drugs, drug doses, and when you took them

It is also important to keep medical insurance. Even though no one wants to think of their cancer coming back, it is always a possibility. If it happens, the last thing you want is to have to worry about paying for treatment.

Lifestyle Changes to Consider During and After Treatment

Having cancer and dealing with treatment can be time-consuming and emotionally draining, but it can also 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 begin this process during cancer treatment.

Make Healthier Choices

Think about your life before you learned you had cancer. Were there things you did that might have made you less healthy? Maybe you drank too much alcohol, or ate more than you needed, or smoked, or didn't exercise very often. Emotionally, maybe you kept your feelings bottled up, or maybe you let stressful situations go on too long.

Now is not the time to feel guilty or to blame yourself. However, you can start making changes today that can have positive effects for the rest of your life. Not only will you feel better but you will also be healthier. What better time than now to take advantage of the motivation you have as a result of going through a life-changing experience like having cancer?

You can start by working on those things that you feel most concerned about. 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's Quitline® tobacco cessation program at 1-800-ACS-2345.

Diet and Nutrition

Eating right can be a challenge for anyone, but it can get even tougher during and after cancer treatment. For instance, treatment often may change your sense of taste. Nausea can be a problem. You may lose your appetite for a while and lose weight when you don't want to. On the other hand, some people gain weight even without eating more. This can be frustrating, too.

If you are losing weight or have taste problems during treatment, do the best you can with eating and remember that these problems usually improve over time. You may want to ask your cancer team for a referral to a dietitian, an expert in nutrition who can give you ideas on how to fight some of the side effects of your treatment. You may also find it helps to eat

small portions every 2 to 3 hours until you feel better and can go back to a more normal schedule.

One of the best things you can do after treatment is to put healthy eating habits into place. You will be surprised at the long-term benefits of some simple changes, like increasing the variety of healthy foods you eat. Try to eat 5 or more servings of vegetables and fruits each day. Choose whole grain foods instead of white flour and sugars. Try to limit meats that are high in fat. Cut back on processed meats like hot dogs, bologna, and bacon. Get rid of them altogether if you can. If you drink alcohol, limit yourself to 1 or 2 drinks a day at the most. And don't forget to get some type of regular exercise. The combination of a good diet and regular exercise will help you maintain a healthy weight and keep you feeling more energetic.

Rest, Fatigue, Work, and Exercise

Fatigue is a very common symptom in people being treated for cancer. This is often not an ordinary type of tiredness but a "bone-weary" exhaustion that doesn't get better with rest. For some, this fatigue lasts a long time after treatment, and can discourage them from physical activity.

However, exercise can actually help you reduce fatigue. Studies have shown that patients who follow an exercise program tailored to their personal needs feel physically and emotionally improved and can cope better.

If you are ill and need to be on bed rest during treatment, it is normal to expect your fitness, endurance, and muscle strength to decline some. Physical therapy can help you maintain strength and range of motion in your muscles, which can help fight fatigue and the sense of depression that sometimes comes with feeling so tired.

Any program of 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 3 times a week. If you haven't exercised in a few years but can still get around, you may want to think about taking short walks.

Talk with your health care team before starting, and get their opinion about your exercise plans. Then, try to get an exercise buddy so that 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, though, you will need to balance activity with rest. It is okay to rest when you need to. It is really hard for some people to allow themselves to do that when they are used to working all day or taking care of a household. For more information about fatigue, please see the publication, *Cancer-Related Fatigue and Anemia Treatment Guidelines for Patients.*

Exercise can improve your physical and emotional health.

- It improves your cardiovascular (heart and circulation) fitness.
- It strengthens your muscles.
- It reduces fatigue.
- It lowers anxiety and depression.
- It makes you feel generally happier.
- It helps you feel better about yourself.

And long term, we know that exercise plays a role in preventing some cancers. The American Cancer Society, in its guidelines on physical activity for cancer prevention, recommends that adults take part in at least 1 physical activity for 30 minutes or more on 5 days or more of the week.

How About Your Emotional Health?

Once your treatment ends, you may find yourself overwhelmed by emotions. This happens to a lot of people. You may have been going through so much during treatment that you could only focus on getting through your treatment.

Now you may find that you think about the potential of your own death, or the effect of your cancer on your family, friends, and career. You may also begin to re-evaluate your relationship with your spouse or partner. Unexpected issues may also cause concern -- for instance, as you become healthier and have fewer doctor visits, you will see your health care team less often. That can be a source of anxiety for some.

This is an ideal time to seek out emotional and social 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 individual counselors.

Almost everyone who has been through cancer can benefit from getting some type of support. 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 realistic to go it all by yourself. And your friends and family may feel shut out if you decide 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-ACS-2345 and we can put you in touch with an appropriate group or resource.

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 healthy choices and feeling as well as possible, physically and emotionally.

What Happens if Treatment Is No Longer Working?

If cancer continues to grow after one kind of treatment, or if it returns, it is often possible to try another treatment plan that might still cure the cancer, or at least shrink the tumors enough to help you live longer and feel better. On the other hand, when a person has received several different medical treatments and the cancer has not been cured, over time the cancer tends to become resistant to all treatment. At this time it's important to weigh the possible limited benefit of a new treatment against the possible downsides, including continued doctor visits and treatment side effects.

Everyone has his or her own way of looking at this. Some people may want to focus on remaining comfortable during their limited time left.

This is likely to be the most difficult time in your battle with cancer -- when you have tried everything medically within reason and it's just not working anymore. Although your doctor may offer you new treatment, you need to consider that at some point, continuing treatment is not likely to improve your health or change your prognosis or survival.

If you want to continue treatment to fight your cancer as long as you can, you still need to consider the odds of more treatment having any benefit. In many cases, your doctor can estimate the response rate for the treatment you are considering. Some people are tempted to try more chemotherapy or radiation, for example, even when their doctors say that the odds of benefit are less than 1%. In this situation, you need to think about and understand your reasons for choosing this plan.

No matter what you decide to do, it is important that you be as comfortable as possible. Make sure you are asking for and getting treatment for any symptoms you might have, such as pain. This type of treatment is called "palliative" treatment.

Palliative treatment helps relieve these symptoms, but is not expected to cure the disease; its main purpose is to improve your quality of life. Sometimes, the treatments you get to control your symptoms are similar to the treatments used to treat cancer. For example, radiation therapy might be given to help relieve bone pain from bone metastasis. Or chemotherapy might be given to help shrink a tumor and keep it from causing a bowel obstruction. But this is not the same as receiving treatment to try to cure the cancer.

At some point, you may benefit from hospice care. Most of the time, this can be given at home. Your cancer may be causing symptoms or problems that need attention, and hospice focuses on your comfort. You should know that receiving hospice care doesn't mean you can’t have treatment for the problems caused by your cancer or other health conditions. It just

means that the focus of your care is on living life as fully as possible and feeling as well as you can at this difficult stage of your cancer.

Remember also that maintaining hope is important. 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. In a way, pausing at this time in your cancer treatment is an opportunity to refocus on the most important things in your life. This 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.

What's New in Non-Small Cell Lung Cancer Research and Treatment?

Lung cancer research is currently being done in medical centers throughout the world. Progress in prevention, early detection, and treatment based on current research is expected to save many thousands of lives each year.

Prevention

Tobacco

At this time, many researchers believe that prevention offers the greatest opportunity to fight lung cancer. Although decades have passed since the link between smoking and lung cancers was clearly identified, scientists estimate that smoking is still responsible for about 85% to 90% of lung cancers. Research is continuing on:

- ways to help people quit smoking through counseling, nicotine replacement, and other medicines
- ways to convince young people to never start smoking
- inherited differences in genes that may make some people exceptionally likely to get lung cancer if they smoke or are exposed to someone else's smoke

Diet and Nutrition

Although researchers are looking for ways to use vitamins or medicines to prevent lung cancer in people at high risk, these have so far not proved successful. For now, most researchers think that simply following the American Cancer Society dietary recommendations (such as maintaining a healthy weight and eating at least 5 servings of fruits and vegetables each day) may be the best strategy.

Early Detection

Nearly 20 years ago, large studies were done to determine whether routine chest x-rays and sputum cytology testing could save lives. Most researchers concluded that these tests did not find lung cancers early enough to significantly lower the risk of death from lung cancer. However, some researchers disagree about the best way to interpret the studies' data, and the debate continues.

A large clinical trial called the National Lung Screening Trial (NLST) is under way to test whether spiral CT scanning of people at high risk of lung cancer will save lives. The results of this study should be coming out in the next few years.

Another approach uses new ways to more sensitively detect cancer cells in sputum samples. Researchers have recently found several changes that often affect the DNA of lung cancer cells. Current studies are looking at new diagnostic tests that specifically recognize these DNA changes to see if this approach is useful in finding lung cancers at an earlier stage.

Diagnosis

Virtual Bronchoscopy

This imaging test uses CT scans to create detailed 3-dimensional pictures of the airways in the lung. The images can be viewed as if the doctor were actually using a bronchoscope.

Virtual bronchoscopy has some possible advantages over standard bronchoscopy. First, it is non-invasive and doesn't require anesthesia. It also allows doctors to see some airways that might not be visible with standard bronchoscopy, such as those being blocked by a tumor. But it has some drawbacks as well. For example, it doesn't show color changes in the airways that might indicate a problem. It also doesn't allow a doctor to take samples of suspicious areas like bronchoscopy does. Still, it can be a useful tool in some situations, such as in people who might be too sick to get a standard bronchoscopy.

This test will likely become more available as the technology improves.

Treatment

Stereotactic Body Radiation Therapy (SBRT)

Stereotactic body radiation therapy (SBRT) is a newer type of treatment. It can be used for very early stage (small) lung cancers when surgery isn't an option, usually for other medical reasons.

Instead of giving small doses of radiation each day for several weeks, SBRT involves giving very focused beams of high-dose radiation on one or a few days. Several beams are aimed at the tumor from different angles. In order to precisely target the radiation, the person is put in a specially designed body frame for each treatment. This reduces the movement of the lung tumor during breathing. Like other forms of external radiation, the treatment itself is painless.

Early results with SBRT have been very promising, and it seems to have a low risk of complications. But because it is still a fairly new technique, there isn't much long-term data on its use.

Chemotherapy

Many clinical trials in progress are comparing the effectiveness of newer combinations of chemotherapy drugs. These studies are also providing information about minimizing side effects, especially in patients who are older and have other health problems. Clinical trials continue to search for better ways to combine chemotherapy with radiation therapy and other treatments.

Targeted Therapies

Researchers are learning more about the molecules within lung cancer cells that control their growth and spread. This is being used to develop new targeted therapies. Many of these treatments are already being tested in clinical trials to see if they can help people with advanced lung cancer live longer or relieve their symptoms. Some of the drugs that are in late stage clinical trials include vandetanib (ZD6474, Zactima), AZD2171, and AMG 706. Some targeted drugs already approved for use against other types of cancer, such as sorafenib (Nexavar), Sunitinib (Sutent), and cetuximab (Erbitux) are also being tested for use against NSCLC.

Researchers are also working on lab tests to help predict which patients will benefit from which drugs. Several clinical trials have already reported that some patients do not benefit from certain targeted therapies, whereas others have quite remarkable shrinkage of their tumors. Predicting who might benefit could save some people from trying treatments that are unlikely to work for them and would likely cause unneeded side effects.

Vaccines: Several types of vaccines for boosting the body's immune response against lung cancer cells are being tested in clinical trials. Unlike vaccines against infections like measles or mumps, these vaccines are designed to help treat, not prevent, lung cancer. One possible advantage of these types of treatments is that they seem to have very limited side effects, so they might be useful in people who can't tolerate other treatments.

Some vaccines are made up of the patient's own tumor cells (removed during surgery). GVAX is an example of this type of vaccine. It is made by removing cancer cells from the patient during surgery and modifying them in the lab to express a growth factor called GM-CSF (to help stimulate the immune system). The cells are irradiated so they can't multiply. They are then injected back into the patient to cause an immune response. Early studies of patients with advanced NSCLC have shown some responses to this vaccine, but further studies are needed.

Other vaccines are made up of lung cancer cells that have been grown in the lab, or even of cell components, such as parts of proteins commonly found on cancer cells. For example, L-BLP25 is a vaccine made up of a piece of a protein (MUC1) that is encased in a fat droplet (liposome) to make it more effective. A small study of patients with advanced NSCLC suggested it may improve survival time. Larger studies are under way to confirm this.

At this time, vaccines are only available in clinical trials.

Additional Resources

More Information From Your American Cancer Society

The following related information may also be helpful to you. These materials may be ordered from our toll-free number, 1-800-ACS-2345.

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

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

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

Questions About Smoking, Tobacco, and Health (also available in Spanish)

Understanding Chemotherapy (also available in Spanish)

Understanding Radiation Therapy (also available in Spanish)

The following books are available from the American Cancer Society. Call us at 1-800-ACS-2345 to ask about costs or to place your order.

American Cancer Society's Guide to Pain Control

Cancer in the Family: Helping Children Cope with a Parent's Illness

Coming to Terms with Cancer: A Glossary of Cancer-Related Terms

American Cancer Society Consumers Guide to Cancer Drugs, Second Edition

Informed Decisions, Second Edition: The Complete Book of Cancer Diagnosis, Treatment, and Recovery

National Organizations and Web Sites*

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

American Lung Association
Telephone: 1-800-586-4872
Internet Address: www.lungusa.org

It's Time to Focus on Lung Cancer
Telephone: 1-877-646-LUNG (1-877-646-5864)
Internet Address: www.lungcancer.org

Lung Cancer Alliance
Telephone: 1-800-298-2436 (United States only)
Internet Address: www.lungcanceralliance.org

National Cancer Institute
Telephone: 1-800-4-CANCER (1-800-422-6237)
Internet Address: www.cancer.gov

**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-ACS-2345 at any time, 24 hours a day.

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For additional assistance please contact your American Cancer Society
1 · 800 · ACS·2345 or www.cancer.org