



# Malignant Mesothelioma

## What is cancer?

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

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

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

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

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

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

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

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

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

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

## What is malignant mesothelioma?

Malignant mesothelioma is a cancer that starts in cells in the linings of certain parts of the body, especially the chest or abdomen.

A layer of specialized cells called mesothelial cells lines the inside of the chest, the abdomen, and the space around your heart. These cells also cover the outer surface of most of your internal organs. The lining formed by these cells is called mesothelium.

The mesothelium helps protect your organs by making a special lubricating fluid that allows organs to move around. For example, this fluid makes it easier for the lungs to move inside the chest during breathing. The mesothelium has different names in different parts of the body:

- In the chest it is called the pleura.
- In the abdomen it is called the peritoneum.
- In the space around the heart it is called the pericardium.

Tumors of the mesothelium can be non-cancerous (benign) or cancerous (malignant).

## Malignant mesothelioma

A cancerous tumor of the mesothelium is called a malignant mesothelioma, although this is often shortened to just mesothelioma. Mesotheliomas can start in 4 main areas in the body.

- **Pleural mesotheliomas** start in the chest. They account for about 3 out of 4 mesotheliomas.
- **Peritoneal mesotheliomas** begin in the abdomen. They make up most of the remaining cases.

- **Pericardial mesotheliomas** start in the covering around the heart and are very rare.
- **Mesotheliomas of the tunica vaginalis** are very rare tumors that start in the covering layer of the testicles, which is actually an outpouching of peritoneum.

Malignant mesotheliomas can also be classified into 4 types based on how the cells are arranged when looked at under a microscope:

- **Epithelioid:** About 50% to 60% of mesotheliomas are of this type. It tends to have a better outlook (prognosis) than the other types.
- **Sarcomatoid (fibrous):** About 10% to 20% of mesotheliomas are of this type.
- **Mixed (biphasic):** These mesotheliomas have both epithelioid and sarcomatoid areas. They make up about 30% to 40% of mesotheliomas.
- **Desmoplastic:** These are rare.

## Benign tumors of the mesothelium

It is important not to confuse malignant mesothelioma with benign tumors that also start in the mesothelium. These benign tumors are typically removed by surgery, and there is usually no need for additional treatment.

### Adenomatoid tumor

This benign tumor can develop in the mesothelium of certain reproductive organs. In men, it often starts in the epididymis (a small collection of ducts that carry sperm cells out of the testicle). In women, this tumor may begin in the fallopian tubes (tubes that carry eggs from the ovaries to the uterus or womb).

### Benign cystic mesothelioma

This is another non-cancerous tumor that may begin in mesothelium near female reproductive organs.

### Solitary fibrous tumor of the pleura

This type of benign tumor can form in the pleura surrounding the lungs. It used to be called *benign fibrous mesothelioma*, but doctors now know that this tumor actually starts from tissue under the mesothelium and not from mesothelial cells. This disease is usually benign, but about 1 in 10 are cancerous. A similar disease starting in the peritoneum is called *solitary fibrous tumor of the peritoneum*.

**Only malignant mesothelioma will be discussed further in this document.**

# What are the key statistics about malignant mesothelioma?

Mesothelioma is fairly rare. About 3,000 new cases of mesothelioma are diagnosed each year in the United States.

The rate of mesotheliomas in the United States increased from the 1970s to the early 1990s and since then has slowly decreased. These changes have largely been seen in men, and are thought to be related to changes in workplace exposures to asbestos (see "What are the risk factors for malignant mesothelioma?"). The rate of mesothelioma is lower in women and has been fairly steady for some time. In many other countries, the rate of mesotheliomas is still increasing.

Mesothelioma is more common in whites and Hispanics/Latinos than in African Americans or Asian Americans.

Information on survival rates for mesothelioma can be found in the section, "How is malignant mesothelioma staged?"

# What are the risk factors for malignant mesothelioma?

A risk factor is anything that affects your chance of getting a disease such as cancer. Different cancers have different risk factors. For example, smoking is a risk factor for cancers of the lung, mouth, larynx (voice box), bladder, kidney, and several other organs.

But risk factors don't tell us everything. Having a known risk factor, or even several risk factors, does not mean that you will get the disease. And some people who get the disease may not have had any known risk factors.

Researchers have found some factors that increase a person's risk of mesothelioma.

## Asbestos

The main risk factor for developing mesothelioma is exposure to asbestos. In fact, most cases of mesothelioma have been linked to asbestos exposure in the workplace.

Asbestos is a group of minerals that occur naturally as bundles of fibers. These fibers, found in soil and rocks in many parts of the world, are made of silicon, oxygen, and other elements.

There are 2 main forms of asbestos:

- **Serpentine** asbestos fibers are curly. The most common asbestos in industrial use, known as chrysotile, or white asbestos, has curly fibers.

- **Amphibole** asbestos fibers are straight and needle-like. There are several types of amphibole fibers, including amosite, crocidolite, tremolite, actinolite, and anthophyllite.

Amphibole fibers (particularly crocidolite) are considered to be more likely to cause cancer, but even the more commonly used chrysotile fibers are linked with mesotheliomas.

When asbestos fibers in the air are inhaled, they tend to stick to mucus in the throat, trachea (windpipe), or bronchi (large breathing tubes of the lungs). Chrysotile fibers tend to be cleared from the lungs by being coughed up or swallowed. But the long, thin amphibole fibers are harder to clear, and they may stay in the lungs, traveling to the ends of the small airways and penetrating into the pleural lining of the lung and chest wall. These fibers may then injure mesothelial cells of the pleura, and eventually cause mesothelioma.

Asbestos fibers can also damage cells of the lung and result in *asbestosis* (scar tissue in the lung) and/or lung cancer. Indeed, asbestosis, mesothelioma, and lung cancer are the 3 most frequent causes of death and disease among people with heavy asbestos exposure.

Peritoneal mesothelioma, which forms in the abdomen, may result from coughing up and swallowing inhaled asbestos fibers.

Many people are exposed to very low levels of naturally occurring asbestos in outdoor air that comes from dust from rocks and soil containing asbestos. The potential for such exposure is higher in areas where rocks have higher asbestos content. In some areas, asbestos may be detected in the water supply as well as in the air.

Because of its heat and fire resistant properties, asbestos has been used in many products such as insulation, floor tiles, door gaskets, soundproofing, roofing, patching compounds, fireproof gloves, ironing board covers, and brake pads. The link between asbestos and mesothelioma has become well known, so its use in the United States has decreased dramatically. Most use stopped after 1989, but it is still used in some products.

Still, millions of Americans may already have been exposed to asbestos. People at risk for workplace asbestos exposure include some miners, factory workers, insulation manufacturers and installers, railroad and automotive workers, ship builders, gas mask manufacturers, and construction workers. Family members of people exposed to asbestos at work also have an increased risk of developing mesothelioma because asbestos fibers can be carried home on the clothes of the workers. The rate of mesothelioma in men appears to be dropping, probably because there is now much less direct exposure to asbestos in the workplace.

Asbestos was also used in the insulation of many older homes, as well as commercial and public buildings around the country, including some schools. Because these particles are contained within the building materials, they are not likely to be found in the air in large numbers. The risk of exposure is thought to be much less hazardous unless the particles are somehow escaping into the air, such as when building materials begin to decompose over time, or during remodeling or removal.

The risk of developing mesothelioma is related to how much asbestos a person was exposed to and how long this exposure lasted. People exposed at an early age, for a long period of time, and at higher levels are more likely to develop this cancer. Mesotheliomas take a long time to develop. The time between first exposure to asbestos and diagnosis of mesothelioma is usually between 20 and 50 years. Unfortunately, the risk of mesothelioma does not go down over time after the exposure to asbestos stops. The risk appears to be lifelong.

For more detailed information on asbestos, see our document, *Asbestos*.

## Zeolites

Zeolites are minerals that are chemically related to asbestos. An example is erionite, which is common in the soil in parts of Turkey. High mesothelioma rates in these areas are believed to be due to exposure to this mineral.

## Radiation

There have been a few published reports of mesotheliomas that developed after exposure to high doses of radiation to the chest or abdomen as a treatment for another cancer. Although the risk of mesothelioma is increased in patients who have been treated with radiation, this cancer still only occurs rarely in these patients.

There have also been reports linking mesothelioma to injections of thorium dioxide (Thorotrast). This radioactive material was used by doctors for certain x-ray tests until the 1950s. Thorotrast was found to cause cancers, so it has not been used for many years.

## SV40 virus

Some studies have raised the possibility that infection with simian virus 40 (SV40) might increase the risk of developing mesothelioma. Some injectable polio vaccines given between 1955 and 1963 were contaminated with SV40. As many as 30 million people in the United States may have been exposed to the virus.

Some lab studies have suggested that SV40 infection may cause mesothelioma. For example, intentional infection with SV40 of some lab animals like hamsters causes mesotheliomas to develop. Researchers also have noticed that SV40 can cause mouse cells grown in lab dishes to become cancerous, and that asbestos increases the cancer-causing effect of SV40 on these cells. Other researchers have found SV40 DNA in some biopsy specimens of human mesotheliomas. But fragments of SV40 DNA can also be found in some non-cancerous human tissues.

So far, the largest studies looking at this issue in humans have not found an increased risk for mesothelioma or other cancers among people who received the contaminated vaccines as children. But the peak age range for diagnosis of mesothelioma is 50 to 70 years. Some researchers have pointed out that this issue may remain unresolved until more of the people accidentally exposed to SV40 between 1955 and 1963 reach that age range.

Most experts have concluded that at this time we still don't know whether SV40 is responsible for some mesotheliomas. Research into this important topic is still under way.

## Age

The risk of mesothelioma increases with age. It is rare in people under age 45. About 3 out of 4 people with mesothelioma are over 65 years old.

## Gender

The disease affects men about 4 times more often than women. This is probably because men have been more likely to work in jobs with heavy exposure to asbestos.

## Do we know what causes malignant mesothelioma?

Cancers, including mesotheliomas, occur when cells in the body suffer damage to their DNA. DNA is the chemical in each of our cells that makes up our *genes* – the instructions for how our cells function. We usually look like our parents because they are the source of our DNA. However, DNA affects more than how we look. Some genes have instructions for controlling when cells in the body grow and divide. Changes in these genes may cause cells to grow out of control, which can lead to cancer.

Asbestos exposure is the main cause of mesothelioma. After these fibers are breathed in, they travel to the ends of small air passages and reach the pleura, where they can damage mesothelial cells. This leads to inflammation and scarring. This may damage DNA and cause changes that result in uncontrolled cell growth. If swallowed, these fibers can reach the abdominal cavity where they have a role in causing peritoneal mesothelioma.

Radiation treatments to treat cancer have been linked to mesothelioma in some studies. Radiation can damage the cells' DNA, leading to out-of-control cell growth.

It is still not known whether infection with the SV40 virus increases the risk of mesothelioma, or exactly how it might do so. In lab studies, researchers have found that the virus can affect certain genes that have been linked with cancer, but further research in this area is needed.

Researchers now understand many of the factors that increase a person's risk of mesothelioma, but it's still not clear exactly how these factors cause the gene changes that lead to cancer. This is an active area of research.

## Can malignant mesothelioma be prevented?

Asbestos exposure is by far the biggest risk factor for mesothelioma, so the best way to reduce your risk of mesothelioma is to limit your exposure to asbestos in homes, in public buildings, and at work.

People who may be exposed to high levels of asbestos at work include some miners, factory workers, insulation manufacturers, railroad and automotive workers, ship builders, gas mask manufacturers, and construction workers, particularly those involved with insulation. If there is a chance of on-the-job exposure, such as during the renovation of old buildings, then you should use all protective equipment, work practices, and safety procedures designed for working around asbestos.

If you live in an older home, there may be asbestos-containing insulation or other materials. A knowledgeable expert can check your home to find out if there is any asbestos and whether it poses any risk of exposure. This may involve testing the air for asbestos levels. Even if asbestos were used in materials to build the home, it may not pose a danger if the materials are in good condition. It is often more dangerous to remove the materials containing asbestos than to leave them alone. If you decide to have the asbestos removed from your home, you should hire a qualified contractor to perform this job to avoid contaminating your home further or causing any exposure to the workers. You should not attempt to remove asbestos-containing material yourself.

Asbestos can also be found in some commercial and public buildings (including some schools), where the same basic principles apply. Intact, undisturbed asbestos-containing materials generally do not pose a health risk. They may pose increased risk if they are damaged, are disturbed in some manner, or deteriorate over time and release asbestos fibers into the air. By federal law, all schools are required to inspect asbestos-containing materials regularly and to have a plan in place for managing them.

## Can malignant mesothelioma be found early?

Mesothelioma is uncommon, and there are no widely recommended screening tests for this cancer in people who are not at increased risk. ("Screening" refers to testing for cancer in people who don't have any symptoms.)

For people with known exposure to asbestos, some doctors recommend imaging tests such as chest x-rays or computed tomography (CT) scans to look for changes in the lungs that might be signs of mesothelioma or lung cancer. But it is not clear how useful these tests are in finding mesotheliomas early.

In recent years, doctors have found that people with mesothelioma often have high levels of certain substances in their blood, including *osteopontin* and *soluble mesothelin-related peptides* (SMRPs). Blood tests for these substances may one day prove useful in finding mesotheliomas early, although right now they are used mainly to monitor the course of the disease in people who are already known to have mesothelioma.

Most mesotheliomas are found when a person goes to a doctor because of symptoms. People who have been exposed to asbestos should know the possible signs and symptoms of mesothelioma (see the section, "How is malignant mesothelioma diagnosed?"). Many of these symptoms are more likely to be caused by something other than mesothelioma,

but it's important to report any new symptoms to your doctor right away so that the cause can be found and treated, if needed.

## How is malignant mesothelioma diagnosed?

Mesothelioma is most often diagnosed after a patient goes to a doctor because of symptoms. If there is a reason to suspect you may have mesothelioma, your doctor will use one or more tests to find out if the disease is present. Symptoms might suggest that a person may have mesothelioma, but tests are needed to confirm the diagnosis.

## Signs and symptoms of mesothelioma

Early symptoms of mesotheliomas are not specific to the disease, and people often ignore them or mistake them for common, minor ailments. Most people with mesothelioma have symptoms for at least a few months before they are diagnosed.

Symptoms of pleural mesothelioma (mesothelioma of the chest) can include:

- Pain in the lower back or at the side of the chest
- Shortness of breath
- Cough
- Fever
- Sweating
- Fatigue
- Weight loss
- Trouble swallowing
- Hoarseness
- Swelling of the face and arms
- Muscle weakness

Symptoms of peritoneal mesothelioma can include:

- Abdominal (belly) pain
- Swelling or fluid in the abdomen
- Weight loss
- Nausea and vomiting

The symptoms and signs above may be caused by mesothelioma, but they are more often caused by other conditions. Still, if you have any of these problems (especially if you

have been exposed to asbestos), 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 mesothelioma, your doctor will want to take a complete medical history to check for symptoms and possible risk factors, especially asbestos exposure. You will also be asked about your general health.

A physical exam can provide information about possible signs of mesothelioma and other health problems. Pleural mesothelioma can cause fluid to build up in the chest cavity (called a *pleural effusion*). In cases of peritoneal mesothelioma, fluid can build up in the abdominal cavity (this is called *ascites*). In cases of pericardial mesothelioma, fluid builds up in the sac around the heart (called a *pericardial effusion*). Rarely, mesothelioma can develop in the groin and look like a hernia. All of these might be found during a physical exam.

If symptoms and/or the results of the physical exam suggest you might have mesothelioma, tests will be needed to make sure. These might include imaging tests, blood tests, and other procedures.

## Imaging tests

Imaging tests use x-rays, radioactive particles, or magnetic fields to create pictures of the inside of your body. Imaging tests may be done for a number of reasons, including to help find a suspicious area that 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 done if someone has symptoms such as a constant cough or shortness of breath. It may show an abnormal thickening of the pleura, calcium deposits on the pleura, fluid in the space between the lungs and the chest wall, or changes in the lungs themselves as a result of asbestos exposure. These findings may suggest a mesothelioma.

### **Computed tomography (CT) scan**

The CT 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 are lying on a narrow table. A computer then combines these into images of slices of the body. Unlike a regular x-ray, a CT scan creates detailed images of the soft tissues in the body.

CT scans are often used to help look for mesothelioma and to determine the exact location of the cancer. They can also help stage the cancer (determine the extent of its

spread). For example, they can show whether the cancer has spread to the liver or other organs. This can help to determine if surgery might be a treatment option. Finally, CT scans can be used to learn whether treatment such as chemotherapy has been helpful in shrinking or slowing the growth of the cancer.

Before any pictures are taken, you may be asked to drink 1 to 2 pints of a liquid called oral contrast. This helps outline the intestine so that certain areas are not mistaken for tumors. You may also receive an IV (intravenous) line through which a different kind of contrast dye (IV contrast) is injected. This helps better outline structures in your body. The injection can cause some flushing (redness and warm feeling). Some people are allergic and get hives or, rarely, more serious reactions like trouble breathing and low blood pressure. Be sure to tell the doctor if you have any allergies or 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 the scan is being done. During the test, the table slides 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. *Spiral CT* (also known as *helical CT*) is now used in many medical centers. This type of CT scan uses a faster machine that reduces the dose of radiation and yields more detailed pictures.

### **Positron emission tomography (PET) scan**

For a PET scan, a radioactive substance (usually a type of sugar related to glucose, known as FDG) is injected into the blood. The amount of radioactivity used is very low. Because cancer cells in the body are growing quickly, they absorb larger amounts of the sugar than most other cells. A special camera can then be used to create a picture of areas of radioactivity in the body.

The picture from a PET scan is not finely detailed like a CT or MRI scan, but it can provide helpful information about whether abnormal areas seen on these tests are likely to be cancerous or not. For example, it can give the doctor a better idea of whether a thickening of the pleura or peritoneum seen on a CT scan is more likely cancer or merely scar tissue. If you have been diagnosed with cancer, your doctor may use this test to see if the cancer has spread to lymph nodes or other parts of the body. A PET scan can also be useful if your doctor thinks the cancer may have spread but doesn't know where.

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

### **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 very detailed images of parts of

the body. A contrast material called gadolinium is often injected into a vein before the scan to better show details.

MRI scans can sometimes help find the exact location and extent of a tumor since they provide very detailed images of soft tissues. For mesotheliomas, they may be useful in looking at the diaphragm (the thin band of muscle below the lungs that helps us breathe), a possible site of cancer spread.

MRI scans take longer than CT scans – often up to an hour. You may be placed inside a large cylindrical tube, which is confining and can upset people with a fear of enclosed spaces. Special, more open MRI machines may be an option in some cases. The MRI machine makes buzzing and clicking noises that you may find disturbing. Some places will provide earplugs to help block this out.

## Blood tests

Blood levels of certain substances are often higher in people with mesothelioma:

- Osteopontin
- Soluble mesothelin-related peptides (SMRPs), detected with the MesoMark<sup>®</sup> test

Blood tests for these substances are not used to diagnose the disease, but high levels may make the diagnosis more likely. Thus far, these blood tests have proven more useful in people who have already been diagnosed to follow their progress during and after treatment.

If mesothelioma is diagnosed, other blood tests will be done to check the blood cell counts and levels of certain chemicals in the blood. These tests can give the doctor an idea of how extensive the disease may be, as well as how well organs such as the liver and kidneys are working.

## Tests of fluid and tissue samples

A person's symptoms and the results of exams, imaging tests, and/or blood tests may strongly suggest that they have mesothelioma, but the actual diagnosis is made by removing cells from an abnormal area and looking at them under a microscope. This is known as a *biopsy*. It may be done in different ways, depending on the situation.

### Removing fluid for testing

If you have a buildup of fluid in the body that may be related to mesothelioma, a sample of this fluid can be removed by inserting a thin, hollow needle through the skin and into the fluid and removing it. Numbing medicine is used on the skin before the needle is inserted. This may be done in a doctor's office or in the hospital.

This procedure has different names depending on where the fluid is:

- **Thoracentesis** removes fluid from the chest cavity.

- **Paracentesis** removes fluid from the abdomen.
- **Pericardiocentesis** removes fluid from the sac around the heart.

The fluid is then tested to see its chemical makeup and is looked at under a microscope to see if there are cancer cells in the fluid. If cancer cells are present, special tests can tell whether the cancer is a mesothelioma, a lung cancer, or another type of cancer.

Not finding any cancer cells in the fluid does not always mean there is no cancer. Even when cancer is present, not all fluid contains cancer cells. In many cases, doctors need to get an actual sample of the pleural or peritoneal tissue to determine if mesothelioma is present.

## **Needle biopsies**

Suspected tumors in the chest are sometimes sampled by needle biopsy. A long, hollow needle is passed through the skin in the chest between the ribs and into the pleura. Imaging tests such as CT scans are used to guide the needle into the tumor so that a small sample can be removed to be looked at under the microscope. This procedure does not require a surgical incision or overnight hospital stay. Still, sometimes the sample removed is not big enough to make an accurate diagnosis, and a more invasive biopsy method may be needed.

A possible complication of this approach is the buildup of air in the pleural space (the area between the lung and the chest wall). This is known as a *pneumothorax*. A small pneumothorax may cause no symptoms and only be found by x-ray, but a larger pneumothorax can lead to the collapse of part of a lung, causing shortness of breath. This can be treated by temporarily placing a small tube through the skin and into the pleural space. The tube is used to suck the air out in order to re-expand the lung.

## **Endoscopic biopsies**

An endoscope is a thin, tube-like instrument used to look at tissues inside the body. It has a light and a lens (or tiny camera) on the end for viewing and often has a tool to remove tissue. Endoscopes have different names depending on the part of the body where they're used. There are a number of different types of endoscopic biopsies.

**Thoracoscopy:** This procedure uses a thoracoscope to look at areas in the chest, including the pleura, and take tissue samples for biopsies. Thoracoscopy is done in the operating room while you are under general anesthesia (in a deep sleep). The doctor inserts the thoracoscope through a small cut made in the chest wall to look at the space between the lungs and the chest wall. (Sometimes more than one cut is made.) This lets the doctor see potential areas of cancer and remove small pieces of tissue to look at under the microscope. Thoracoscopy can also be used to sample lymph nodes and fluid and to assess whether a tumor is growing into nearby tissues or organs.

**Laparoscopy:** For this test, the doctor uses a laparoscope to look inside the abdomen and take biopsies of any peritoneal tumors. The patient is first put under general anesthesia.

Then, a laparoscope is inserted into the abdomen through small cuts on the front of the abdomen.

**Mediastinoscopy:** If imaging tests such as a CT scan suggest that the cancer may have spread to the lymph nodes between the lungs, the doctor may want to remove some of them to see if they really contain cancer. This may be done during a procedure called a mediastinoscopy. This is also done in an operating room while you are under general anesthesia (in a deep sleep). A small cut is made in the front of the neck above the breastbone (sternum) and a thin, hollow, lighted tube (called a *mediastinoscope*) is inserted behind the sternum. 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. Cancers in the lung often spread to lymph nodes, but mesotheliomas do this less often. Tests on lymph nodes can give the doctor information on whether a cancer is still localized or if it has started to spread and can help distinguish lung cancer from mesothelioma.

**Bronchoscopy:** This test uses a bronchoscope – a long, thin, flexible, fiber-optic tube that is placed down the throat and into the lungs. It is used to look at the lining of the lung's main airways. This procedure is done with the patient asleep or sedated. If a tumor is found, the doctor can take a small sample of the tumor through the tube.

## **Open surgical biopsy**

In some cases, more invasive procedures may be needed to get a large enough tissue sample to make a diagnosis. Surgery, either a thoracotomy (which opens the chest cavity) or a laparotomy (which opens the abdominal cavity), allows the surgeon to remove a larger sample of tumor or, sometimes, to remove the entire tumor.

## **Testing the samples in the lab**

No matter which approach used to obtain them, biopsy and fluid specimens are sent to the pathology lab. There, a doctor will look at them under a microscope and do other tests to find out whether cancer is present (and if so, what type of cancer it is).

It is often hard to diagnose mesothelioma by looking at the cells from the fluid around the lungs, abdomen, or heart. It can even be hard to diagnose mesothelioma with tissue from small needle biopsies. Under the microscope, mesothelioma can look like several other types of cancer. For example, pleural mesothelioma may resemble some types of lung cancer, and peritoneal mesothelioma may look like some cancers of the ovaries.

For this reason, special lab tests are often done to help distinguish mesothelioma from some other cancers.

- **Immunohistochemistry tests** look for different proteins on the surface of the cells. It can be used to tell if the cancer is a mesothelioma or a lung cancer, which can sometimes appear to start in the lining of the chest cavity.

- **DNA microarray analysis** is a newer test that actually looks at patterns of genes in the cancers. Mesotheliomas have different gene patterns than other cancers.
- **Electron microscopy** can sometimes help diagnose mesothelioma. The electron microscope can magnify samples more than 100 times greater than a normal light microscope. This more powerful microscope makes it possible to see the small parts of the cancer cells that distinguish mesothelioma from other types of cancer.

If mesothelioma is diagnosed, the doctor will also determine what type of mesothelioma it is, based on the patterns of cells seen in the microscope. Most mesotheliomas are classified as either epithelioid, sarcomatoid, or mixed/biphasic.

## Pulmonary function tests

Pulmonary function tests (PFTs) may be done after mesothelioma is diagnosed to see how well your lungs are working. This is especially important if surgery is an option in treating the cancer. Because surgery often involves removing part or all of a lung, it's important to know how well the lungs are working to start with. These tests can give the surgeon an idea of whether surgery may be an option, and if so, how much lung can safely be removed.

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 a machine that measures lung function.

## How is malignant mesothelioma staged?

Staging is the process of finding out how far a cancer has spread. Your treatment and prognosis (outlook) 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, PET scan, *etc.*), which are described in the section, "How is malignant mesothelioma diagnosed?"

Since pleural mesothelioma occurs most frequently and has been studied the most, it is the only mesothelioma for which a staging system exists.

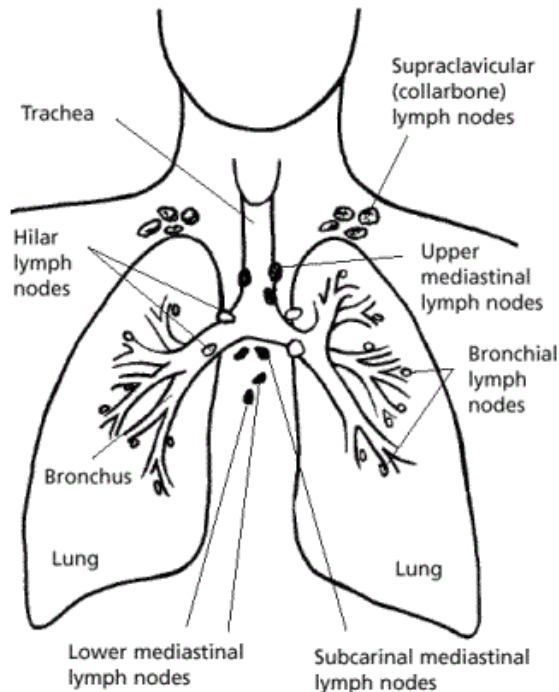
## The TNM staging system

The system most often used to describe the growth and spread of pleural mesothelioma is the American Joint Committee on Cancer (AJCC) **TNM** staging system. The TNM system is based on 3 key pieces of information:

- **T** indicates the extent of spread of the main (primary) **tumor**.
- **N** describes how much the cancer has spread to nearby (regional) lymph **nodes**. Lymph nodes are small bean-shaped collections of immune system cells to which cancers often spread first.

- **M** indicates whether the cancer has spread (**metastasized**) to other organs of the body. (The most common sites are the pleura on the other side of the body, the lungs, and the peritoneum.)

Numbers or letters appear after T, N, and M to provide more details about each of these factors. Higher numbers mean the cancer is more advanced.



## T groups

**TX:** The main tumor can't be assessed for some reason.

**T0:** There is no evidence of a main tumor (the cancer is found elsewhere instead).

**T1:** Mesothelioma involves the pleura lining the chest wall on one side of the chest. It may or may not also affect the pleura lining the diaphragm (the breathing muscle) or the mediastinum (the space between the lungs). It may also have spread to the pleura covering the lung as well.

**T2:** Mesothelioma involves the pleura lining the chest wall on one side of the chest. It also involves the pleura coating the diaphragm, the mediastinum, and the lung. It has grown into at least one of the following, as well:

- The diaphragm
- The lung itself

**T3:** The mesothelioma has grown further but may still possibly be removed with surgery. The tumor involves the pleura lining the chest wall on one side of the chest. It also

involves the pleura coating the lung, the diaphragm, and the mediastinum. It has grown into at least one of the following, as well:

- The first layer of the chest wall (called the *endothoracic fascia*)
- The fatty part of the mediastinum
- A single place in the deeper layers of the chest wall
- The surface of the pericardium (outer covering layer of the heart)

**T4:** The mesothelioma has grown too far to be removed completely with surgery. The tumor involves the pleura lining the chest wall on one side of the chest. It also involves the pleura coating the lung, diaphragm, and mediastinum on the same side. It has grown into at least one of the following, as well:

- More than one place in the deeper layers of the chest wall, including the muscle or ribs
- Through the diaphragm and into the peritoneum
- Any organ in the mediastinum (esophagus, trachea, thymus, blood vessels)
- The spine
- Across to the pleura on the other side of the chest
- Through the heart lining or into the heart itself

## **N groups**

**NX:** The nearby lymph nodes can't 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 (called *hilar* or *bronchial* lymph nodes) on the same side as the mesothelioma.

**N2:** Spread to other lymph nodes on the same side as the cancer, such as the *subcarinal* (around the point where the windpipe branches into the left and right bronchi) and the *mediastinal* lymph nodes. Also includes spread to the lymph nodes in the space behind the breastbone (called *internal mammary* lymph nodes), those in front of the heart, and those near the diaphragm (called *peridiaphragmatic*).

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

## **M groups**

**M0:** No spread to distant organs or areas.

**M1:** The cancer has spread to distant sites. This can be to distant lymph nodes or to other organs.

## **Stage grouping for pleural mesothelioma**

Once the T, N, and M categories have been assigned, this information is combined in a process called stage grouping to assign an overall stage of I, II, III, or IV. The stages identify tumors that have a similar prognosis and thus are treated in a similar way. Patients with lower stage numbers tend to have a better prognosis.

### **Stage I**

**T1, N0, M0:** Mesothelioma involves the pleura lining the chest wall on one side of the chest. It may or may not also affect the pleura lining the diaphragm (the breathing muscle) or the mediastinum (the space between the lungs). It may also have spread to the pleura covering the lung (T1). It has not spread to the lymph nodes (N0) or to distant sites (M0).

### **Stage II**

**T2, N0, M0:** Mesothelioma involves the pleura lining the chest wall on one side of the chest. It also involves the pleura coating the diaphragm, the mediastinum, and the lung. The cancer has also grown into the diaphragm or the lung itself (T2). It has not spread to the lymph nodes (N0) or to distant sites (M0).

### **Stage III**

Either of the following:

**T1 or T2, N1 or N2, M0:** Mesothelioma involves the pleura lining the chest on one side, and may or may not have grown into the pleura lining the lung, the diaphragm, or the mediastinum. It may also have grown into the muscle of the diaphragm or the lung itself (T1 or T2). It has spread to lymph nodes in the chest on the same side as the cancer (N1 or N2). It has not spread to distant sites (M0).

### **OR**

**T3, N0 to N2, M0:** Mesothelioma involves the pleura lining the chest on one side, and has grown into the first layer of the chest wall, the fatty part of the mediastinum, a single place in the deeper layers of the chest wall, or the outer covering layer of the heart. It may or may not have spread to lymph nodes in the chest on the same side as the tumor but has not spread to lymph nodes near the collarbone or on the opposite side of the chest (N0, N1, or N2). It has not spread to distant sites (M0).

### **Stage IV**

Any of the following:

**T4, any N, M0:** Mesothelioma involves the pleura lining the chest on one side and has grown into more than one place in the deeper layers of the chest wall (including the muscle or ribs), through the diaphragm and into the peritoneum, into any organ in the mediastinum, into the spine, across to the pleura on the other side of the chest, and/or through the heart lining or into the heart itself. It may or may not have spread to lymph nodes (any N). It has not spread to distant sites (M0).

**OR**

**Any T, N3, M0:** The tumor is of any size and may or may not have grown into nearby tissues (any T). It has spread to lymph nodes near the collarbone on either side and/or to hilar or mediastinal lymph nodes on the side opposite the primary tumor (N3). It has not spread to distant sites (M0).

**OR**

**Any T, any N, M1:** The mesothelioma is of any size and may or may not have grown into nearby tissues (any T). It may or may not have spread to the lymph nodes (any N). It has spread to distant sites (M0).

## Resectable versus unresectable cancer

The TNM system divides mesotheliomas into several stages that help give doctors an idea about a person's prognosis (outlook). But for treatment purposes, doctors often use a simpler system based on whether these cancers are likely to be resectable (where all visible tumor can be removed by surgery) or unresectable.

In general terms, most stage I, II, and III mesotheliomas are potentially resectable, but there are exceptions. Whether or not the cancer can be removed depends not only on the size of the tumor and how far it has grown into nearby tissues, but also on the subtype (most doctors believe only epithelioid tumors are potentially resectable), where it is located, and whether or not a person is healthy enough to have surgery.

Even for resectable mesotheliomas, in most cases there are cancer cells that cannot be seen that are left behind after surgery. For this reason, many doctors advise using other forms of treatment (radiation therapy and/or chemotherapy) along with surgery when possible.

## Other prognostic factors

Stage is an important factor in predicting a patient's prognosis (outlook), but other factors also play a role. Some factors linked to longer survival times include:

- Good performance status (being able to carry out normal tasks of daily life)
- Younger age
- Epithelioid subtype
- Not having chest pain

- No significant weight loss
- Normal levels of a substance in the blood called LDH
- Normal red blood cell counts, white blood cell counts, and blood platelet counts

## Survival statistics for mesothelioma

Survival rates are often used by doctors as a standard way of discussing a person's prognosis (outlook). Some patients may want to know the survival statistics for people in similar situations, while others may not find the numbers helpful, or may even not want to know them. Whether or not you want to read about the survival statistics below for mesothelioma is up to you.

In order to get survival rates, doctors have to look at people who were treated at least several years ago. Although the numbers below are among the most current we have available, improvements in treatment since then may result in a more favorable outcome for people now being diagnosed with mesothelioma.

Survival rates are often based on previous outcomes of large numbers of people who had the disease, but they cannot predict what will happen in any particular person's case. Knowing the type and the stage of a person's cancer is important in estimating their outcome. But many other factors may also affect a person's outcome, such as a person's overall health and how well the cancer responds to treatment. Even when taking these other factors into account, survival rates are at best rough estimates. Your doctor can tell you if the numbers below may apply, as he or she is familiar with the aspects of your particular situation.

Mesothelioma is a serious disease. By the time the symptoms appear and cancer is diagnosed, the disease is often advanced. But regardless of the extent of the cancer, it can be very hard to treat.

In the medical literature, *average* survival times for people with mesothelioma have ranged between 4 and 18 months, depending on the study. But some people live much longer. Between 5 and 10% of people with mesothelioma live at least 5 years after being diagnosed.

Because these cancers are not common, it is hard to find accurate survival rates based on the TNM stage of the cancer. As a general rule, survival times are likely to be higher for people with mesotheliomas that can be operated on than for those with cancers that have spread too far to be removed. Other prognostic factors, such as those listed in the previous section, may also affect survival.

## How is malignant mesothelioma 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. If you have mesothelioma, your cancer care team will recommend one or more treatment options for you to consider. This is an important decision and you should take time to think about all of your choices.*

The next few sections describe the various types of treatments used for mesotheliomas. This is followed by a section that describes the most common approaches used based on the extent of the disease.

## Making treatment decisions for malignant mesothelioma

After the tumor is found and staged, your cancer care team will discuss your treatment options with you. The main factors in selecting a treatment for mesotheliomas are the size and location of the tumor, whether it has spread to lymph nodes or other organs, and your health and personal preferences.

Because mesothelioma is a rare cancer, it has been hard for doctors to compare the value of different treatments. Only a few large clinical trials of treatments for mesothelioma have been done. In addition, many doctors have little or no experience treating this disease. They usually refer patients with this cancer to specialists who treat large numbers of mesothelioma patients at major medical centers.

You may have different types of doctors on your treatment team, depending on the stage of your cancer and your treatment options. These doctors may include:

- A thoracic surgeon: a doctor who treats diseases of the lungs and chest with surgery.
- A radiation oncologist: a doctor who treats cancer with radiation therapy.
- A medical oncologist: a doctor who treats cancer with medicines such as chemotherapy.
- A pulmonologist: a doctor who specializes in medical treatment of diseases of the lungs.

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

Mesothelioma is often hard to treat because it typically does not grow as a single tumor mass. It tends to spread along nearby surfaces, nerves, and blood vessels. This makes it very difficult, except in rare situations, to completely get rid of it with surgery and/or radiation.

Before deciding on a treatment option, it's very important to have an idea of its likely benefits and possible risks. You will probably have many questions about the treatment options suggested. Mesotheliomas are rare, so if time permits it is often a good idea to seek a second opinion from a doctor who has a lot of experience in treating people with

these cancers. A second opinion can provide more information and help you feel more confident about the treatment plan that you choose.

## Surgery for malignant mesothelioma

Surgery for mesothelioma may be done for 1 of 2 reasons: to try to cure the cancer or to relieve (palliate) pain and other symptoms caused by the tumor.

Surgery to try to cure the cancer is also known as *potentially curative surgery*. This type of surgery may be an option if you are in otherwise good health and the cancer has not spread too far to be removed completely. Unfortunately, even when the surgeon can remove all of the cancer that can be seen, some cancer cells are often left behind. These cells can grow and divide, causing the cancer to come back some time after surgery. Because of this, not all doctors agree on the exact role of surgery. In most cases it is not likely to cure you but may extend your life. Still, potentially curative surgery is being done in some major cancer centers, and a small number of patients who have had the surgery have had long remissions of their disease.

*Palliative surgery* may be an option if the tumor has already spread beyond the mesothelium and is difficult to remove completely, or if you are too ill for a more extensive operation. The goal of this surgery is to relieve or prevent symptoms, as opposed to trying to cure the cancer.

## Surgery for pleural mesothelioma

Surgery for pleural mesothelioma may be done either to help prevent or relieve symptoms or to try to remove all of the cancer. Unfortunately, these tumors are often too extensive to be removed completely.

**Extrapleural pneumonectomy (EPP):** This is an extensive operation that removes the pleura lining the chest wall, part of the diaphragm, the pericardium, nearby lymph nodes, and the whole lung on the side of the tumor. The diaphragm and the pericardium are then reconstructed with man-made materials. This is a difficult operation and is done only by surgeons in large medical centers. You must be in good overall health with good lung function and no other serious illnesses to tolerate this surgery. Several tests must be done to assess whether you are healthy enough for this surgery. Major complications occur in as many as 1 in 4 people who have this operation. This surgery is most often used when the surgeon thinks a cure is possible – typically in patients with resectable mesothelioma of the epithelioid type who do not have cancer spread to the lymph nodes.

**Pleurectomy/decortication:** Pleurectomy/decortication (P/D) is a less extensive operation. In this procedure all of the pleura lining the chest wall (on one side) is removed. The pleura coating the lung on that same side is also removed, as is the pleura coating the mediastinum and the diaphragm. The lung and diaphragm are not removed. This surgery can be used to try to cure some cancers, but it is also used as a palliative procedure to relieve symptoms in cases where the entire tumor cannot be removed. It can help control the buildup of fluid, improve breathing, and decrease pain caused by the cancer.

**Debulking:** The goal of this surgery is to remove as much of the mesothelioma as possible. In general, less tissue is removed in this operation than in a P/D procedure.

## **Surgery for peritoneal mesothelioma**

Surgical treatment of peritoneal mesothelioma is often done either to help relieve symptoms or to remove the tumor from the wall of the abdomen and other digestive organs. As with pleural mesothelioma, these tumors are often too extensive to be removed completely.

**Debulking:** The goal of this surgery is to remove as much of the mesothelioma as possible. Sometimes this means removing pieces of the intestine.

**Omentectomy:** The omentum is an apron-like layer of fatty tissue that drapes over the contents of the abdomen. Cancers involving the peritoneum often spread to this tissue, so it may be removed as part of surgery for peritoneal mesothelioma.

## **Surgery for pericardial mesothelioma**

Surgery can be done to remove a mesothelioma from the pericardium (the sac around the heart).

## **Surgery for mesothelioma of the tunica vaginalis testis**

Surgery for mesothelioma of the tunica vaginalis testis, which occurs in the groin, rarely cures this cancer. Most of the time surgery is done because the tumor resembles a hernia. The surgeon attempts to treat a suspected hernia and only realizes the diagnosis after the surgery is begun. This kind of mesothelioma typically can't be removed entirely.

## **Other palliative procedures**

Several less invasive procedures can be used to control some of the symptoms caused by mesotheliomas, especially those due to the buildup of fluid.

**Removal of fluid:** Procedures such as thoracentesis, paracentesis, and pericardiocentesis can be used to remove fluid that has built up and is causing symptoms. In these procedures, a doctor uses a long, hollow needle to remove the fluid from a body cavity. These procedures are described in the section, "How is malignant mesothelioma diagnosed?" The major drawback with these techniques is that the fluid often builds up again, so they may need to be repeated.

**Pleurodesis:** This procedure may be done to try to prevent fluid from building up in the chest cavity. A small cut is made in the skin of chest wall, and a hollow tube (called a *chest tube*) is placed into the chest so that the fluid can drain out. Then the doctor puts a substance through the chest tube and into the chest cavity, such as talc mixed in a fluid (talc slurry), the antibiotic doxycycline, or the chemotherapy drug bleomycin. Talc powder can also be sprayed into the chest cavity as an aerosol from a pressurized can. 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. Pleurodesis can also be done at the time of thoracoscopy.

**Shunt placement:** A shunt is a device that enables fluid to move from one part of the body to another. For example, a pleuro-peritoneal shunt allows fluid in the chest to move into the abdomen, where it is more likely to be absorbed by the body. The shunt is a long, thin, flexible tube with a small pump in the middle. In the operating room, the doctor inserts one end of the shunt into the chest cavity and the other end into the peritoneum. (The pump is placed just under the skin over the ribs.) Once the shunt is in place, the patient uses the pump several times a day to move the fluid from the chest to the abdomen. This approach may be used if pleurodesis or other techniques are not effective.

**Catheter placement:** This is another approach sometimes used to control the buildup of fluid. One end of the catheter (a thin, flexible tube) is placed in the chest or abdomen and the other end is left outside the body. This is done in a doctor's office or hospital. Once in place, the catheter can be attached to a special bottle or other device to allow the fluid to drain out on a regular basis.

## Radiation therapy for malignant mesothelioma

Radiation therapy uses high-energy x-rays or particles to kill cancer cells. Mesotheliomas are often hard to treat with radiation therapy. They are not usually contained as single, discrete tumors, so aiming radiation at them while avoiding nearby normal tissues is difficult. But new radiation therapy techniques may make this form of treatment more useful.

### Uses of radiation therapy

Radiation therapy may be used in different ways to treat mesothelioma:

- It can be used after surgery to try to kill any small areas of cancer that could not be seen and removed during surgery. This is called adjuvant radiation therapy.
- Radiation therapy can be used to ease symptoms of mesothelioma such as shortness of breath, pain, bleeding, and trouble swallowing.

### Types of radiation therapy

There are 2 main types of radiation therapy that can be used to treat mesothelioma:

**External beam radiation therapy (EBRT):** This type of radiation therapy uses x-rays from a machine outside the patient's body to kill cancer cells. It is the most common form of radiation therapy for mesothelioma. The treatment is much like getting an x-ray, but the radiation is more intense. The procedure itself is painless. Before your treatments start, the medical team will take careful measurements to find the correct angles for aiming the radiation beams and the proper dose of radiation. 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 several weeks.

With newer techniques, doctors can more accurately treat mesotheliomas while reducing the radiation exposure to nearby healthy tissues such as the lungs. This may offer a better chance of increasing the success rate and reducing side effects.

For example, *intensity-modulated radiation therapy (IMRT)* is an advanced form of 3-dimensional radiation therapy. It uses a computer-driven machine that moves around the patient as it delivers radiation. Along with shaping the radiation beams and aiming them at the tumor from several angles, the intensity (strength) of the beams can be adjusted to limit the dose reaching nearby normal tissues.

**Brachytherapy:** When a radiation source is placed inside the body, it is called *brachytherapy*. When this type of radiation therapy is used for mesothelioma, the doctor places radioactive material directly into the chest or the abdomen at the site of the cancer. The radiation given off travels only a very short distance, which limits the potential damage to nearby healthy tissues. Brachytherapy is seldom used for this type of cancer.

## Possible side effects

Side effects of external radiation therapy may include fatigue and sunburn-like skin problems and hair loss where the radiation enters the body. These usually go away once treatment is finished. Chest radiation therapy may cause lung damage and lead to trouble breathing and shortness of breath. Abdominal radiation therapy may cause nausea, vomiting, diarrhea, and a loss of appetite.

If radiation therapy is used together with chemotherapy, it may make the side effects of chemotherapy worse.

If you are having any side effects from radiation therapy, talk with your doctor. In most cases there are ways to help control these symptoms.

For more general information about radiation therapy, please see our document, *Understanding Radiation Therapy: A Guide for Patients and Families*.

## Chemotherapy for malignant mesothelioma

Chemotherapy (chemo) is treatment with anti-cancer drugs. There are 2 main ways that chemotherapy can be given to treat mesothelioma.

In *systemic* therapy, chemotherapy is swallowed in pill form or injected into a vein. The drug enters the bloodstream and circulates throughout the body to reach and destroy the cancer cells wherever they may be.

Chemotherapy drugs can also be placed directly into the body cavity where the cancer is – either *intrapleurally* (directly into the chest cavity) or *intraperitoneally* (into the abdominal cavity) through a small catheter (tube) placed in the chest or abdominal wall through a small incision. Chemotherapy drugs given this way are still absorbed into the

bloodstream, but the highest concentration goes directly to where the cancer cells are. This approach may let doctors give higher doses of chemotherapy to the tumor while limiting the side effects to the rest of the body. Chemotherapy drugs given this way are sometimes heated first (called *hyperthermic chemotherapy*), which may help them work better. Sometimes this treatment is given as a single dose in the operating room, right after surgery to remove the cancer.

For mesotheliomas that can be treated with surgery, chemotherapy may be given before surgery to shrink the cancer and lower the risk of spread. This is called *neoadjuvant therapy*. Chemo can also be given after surgery to try to kill any cancer cells that were left behind because they were too small to be seen. This type of treatment, called *adjuvant therapy*, may help delay or prevent the cancer from growing back, improving the outcome. For cancers that are not resectable, chemotherapy may be the main treatment (alone or along with radiation therapy). Chemotherapy may slow the progression of the disease, but it is very unlikely to make it go away completely.

Doctors usually 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. Chemotherapy is often not recommended for patients in poor health, but advanced age by itself is not a barrier to getting chemotherapy.

Several chemotherapy drugs have been used to treat mesothelioma. Most doctors now use a combination of the drugs pemetrexed (Alimta<sup>®</sup>) and cisplatin. Pemetrexed lowers levels of folic acid and vitamin B12 in the body, so these must also be given to avoid certain side effects.

Other chemotherapy drugs used to treat mesothelioma include:

- Gemcitabine (Gemzar<sup>®</sup>)
- Carboplatin
- Methotrexate
- Vincristine
- Vinblastine
- Mitomycin
- Doxorubicin (Adriamycin<sup>®</sup>)
- Epirubicin (Ellence<sup>®</sup>)
- Cyclophosphamide (Cytoxan<sup>®</sup>)
- Ifosfamide (Ifex<sup>®</sup>)

These drugs are usually given in combinations of 2 or more, but single drugs can be used in people who may not be able to tolerate combinations of drugs. Several other drugs are also being studied for use against mesothelioma.

## Possible side effects

Chemotherapy drugs attack 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 you are given and on how long they are used for. Common side effects include:

- Hair loss
- Mouth sores
- Loss of appetite
- Nausea and vomiting
- Diarrhea
- 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 drugs that can be given to help prevent or reduce nausea and vomiting. Be sure to ask your doctor or nurse about medicines to help reduce side effects, and let him or her know when you do have side effects so they can be managed effectively.

Some drugs can have other side effects. For example, cisplatin can damage nerves (called *neuropathy*). This can sometimes lead to hearing loss or symptoms in the hands and feet such as pain, burning or tingling sensations, sensitivity to cold or heat, or weakness. In most cases this goes away once treatment is stopped, but it may last a long time in some people. You should report this, as well as any other side effects or changes you notice while getting chemotherapy, to your medical team so that you can get prompt treatment for them. 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 our document, *Understanding Chemotherapy: A Guide for Patients and Families*.

## Clinical trials for malignant mesothelioma

You may have had to make a lot of decisions since you've been told you have cancer. One of the most important decisions you will make is choosing which treatment is best for you. You may have heard about clinical trials being done for your type of cancer. Or maybe someone on your health care team has mentioned a clinical trial to you.

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

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

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

Clinical trials are one way to get state-of-the-art cancer treatment. They are the only way for doctors to learn better methods to treat cancer. Still, they are not right for everyone.

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

## Complementary and alternative therapies for malignant mesothelioma

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

### **What exactly are complementary and alternative therapies?**

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

**Complementary methods:** Most complementary treatment methods are not offered as cures for cancer. Mainly, they are used to help you feel better. Some methods that are used along with regular treatment are meditation to reduce stress, acupuncture to help relieve pain, or peppermint tea to relieve nausea. Some complementary methods are known to help, while others have not been tested. Some have been proven not to be helpful, and a few have even been found harmful.

**Alternative treatments:** Alternative treatments may be offered as cancer cures. These treatments have not been proven safe and effective in clinical trials. Some of these methods may pose danger, or have life-threatening side effects. But the biggest danger in

most cases is that you may lose the chance to be helped by standard medical treatment. Delays or interruptions in your medical treatments may give the cancer more time to grow and make it less likely that treatment will help.

## **Finding out more**

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

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

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

## **The choice is yours**

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

## **Treatment of mesothelioma based on the extent of the cancer**

The stage (extent) of a mesothelioma is an important factor in determining treatment options. But other factors, such as whether the doctor feels the cancer is resectable by surgery and person's general health and preferences also play a role.

Mesotheliomas can be hard to treat, no matter what stage of the cancer is. It's very important that you understand the goal of treatment before it starts – whether it is to try to cure the cancer or to help relieve symptoms – as well as the possible benefits and risks. This can help you make an informed decision when looking at your treatment options.

## **Resectable mesotheliomas**

In general, most stage I and some stage II and III pleural mesotheliomas are potentially resectable, but there are exceptions. Resectability is based not only on the size of the

tumor, but also on the subtype (most doctors believe only epithelioid tumors are potentially resectable), where it is located, how far it has grown into nearby tissues, and whether or not a person is healthy enough to have surgery.

Many patients with resectable pleural mesothelioma have their cancer removed by pleurectomy/decortication or extrapleural pneumonectomy (EPP). Surgery is more likely to result in long-term benefit in stage I cancers, where there is a better chance that most or all of the cancer can be removed. For these early stage cancers, EPP may be a good option if it can be done. Patients with peritoneal mesotheliomas in an early stage might also benefit from surgery. Some patients can have long remissions after extensive surgery by experts. Surgery may still be helpful for later stage cancers, but the benefits are more likely to be short term.

Doctors are still studying whether giving chemotherapy before surgery (*neoadjuvant therapy*) or giving chemotherapy or radiation therapy after surgery (*adjuvant therapy*) is helpful. Many doctors advise adjuvant therapy, but not all doctors agree on when to use it or what the best course of treatment is.

If you are not healthy enough to tolerate a major operation, radiation therapy and/or chemotherapy may be used instead. While these treatments may shrink or slow the growth of the cancer for a time, they are not likely to result in a cure.

If you have symptoms because of fluid buildup in the chest or abdomen, other approaches such as thoracentesis/paracentesis or pleurodesis (described in the “Surgery” section) may be helpful.

Because these cancers can be hard to treat, taking part in a clinical trial of a newer form of treatment may be a reasonable option. These types of studies are usually done in large medical centers.

## **Unresectable mesotheliomas**

Stage IV mesotheliomas, as well as many earlier stage mesotheliomas, can't be removed completely by surgery either because of the extent of the disease or because a person may not be able to tolerate an operation. Chemotherapy and/or radiation therapy may shrink or slow the growth of the cancer for a time. But these treatments are very unlikely to result in a cure and can have their own side effects. Before starting such treatments, the goals of treatment should be clear to you and your family.

Because these cancers can be hard to treat, taking part in a clinical trial of a newer form of treatment may be a reasonable option.

In many cases, treatment aimed at relieving symptoms and making you comfortable may be a good choice. This could include treatments that prevent or reduce fluid buildup in the body, which could affect your breathing or ability to take in nutrition.

Pain management is another important aspect of your care. Some minor operations and types of radiation therapy can help relieve pain if needed. Doctors can also prescribe strong pain-relieving drugs. Some people with cancer may hesitate to use opioid drugs

(such as morphine) for fear of being sleepy all the time or becoming addicted to them. But many people get very effective pain relief from these medicines without serious side effects. It's very important to let your cancer care team know if you are having pain so that it can be treated effectively.

## **Recurrent mesotheliomas**

Cancer is called *recurrent* when it come backs after treatment. Recurrence can be local (in or near the same place it started) or distant (spread to organs such as the brain or liver). Mesotheliomas often come back after the initial treatment. If this happens, further treatment options depend on where the cancer is, what treatments have already been used, and a person's general health. In most cases the options will be similar to those listed above for unresectable mesotheliomas. For example, chemotherapy may be used to try to shrink or slow the growth of the cancer and to relieve any symptoms. Because recurrent cancers can often be hard to treat, clinical trials of new types of treatment may be a good option.

## **More treatment information for malignant mesothelioma**

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

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

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](http://www.nccn.org)).

## **What should you ask your doctor about malignant mesothelioma?**

As you cope with cancer and cancer treatment, you need to have honest, open discussions with your doctor. You should feel free to ask any question that's on your mind no matter how small it might seem. Here are some questions you might want to ask. Nurses, social workers, and other members of the treatment team may also be able to answer many of your questions.

- What kind of mesothelioma do I have?
- Has my cancer spread beyond the primary site?
- What is the stage (extent) of my cancer, and what does that mean in my case?
- Is my cancer likely to be resectable?

- Are there other tests that need to be done before we can decide on treatment?
- Are there other doctors I need to see?
- How much experience do you have treating this type of cancer?
- Should I get a second opinion?
- What treatment options do I have?
- What is the goal of treatment?
- What do you recommend and why?
- What risks or side effects are there to the treatments you suggest?
- What should I do to be ready for treatment?
- How long will treatment last? What will it involve? Where will it be done?
- How will treatment affect my daily activities?
- What would we do if the treatment doesn't work or if the cancer recurs?
- What type of follow-up might I need after treatment?

In addition to these sample questions, be sure to write down some of your own. For instance, you might want more information about recovery times. Or you may want to ask about clinical trials for which you may qualify.

## What happens after treatment for malignant mesothelioma?

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

It may take a while before your fears lessen. But it may help to know that many cancer survivors have learned to live with this uncertainty and are living full lives. Our document, *Living With Uncertainty: The Fear of Cancer Recurrence*, gives more detailed information on this.

For many people, the mesothelioma may never go away completely. These people may get regular treatments with chemotherapy, radiation therapy, or other therapies to help keep the cancer in check. Learning to live with cancer that doesn't go away can be difficult and very stressful. It has its own type of uncertainty.

## Follow-up care

If you have completed treatment, your doctors will still want to watch you closely. It is very important to keep all follow-up appointments. During these visits, your doctors will ask about symptoms, do physical exams, and may order blood tests (such as the osteopontin or MesoMark tests) or imaging tests such as CT scans or PET scans. There is no widely agreed upon follow-up schedule for people with mesothelioma. Your doctor will most likely want to see you fairly frequently (every couple of months or so) at first. The time between visits may be extended if there are no problems.

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.

If the cancer does recur at some point, further treatment will depend on the location of the cancer, what treatments you've had before, and your health. For more information on how recurrent cancer is treated, see the section "Treatment of mesothelioma based on the extent of the cancer." For more general information on dealing with a recurrence, you may also want to our document, *When Your Cancer Comes Back: Cancer Recurrence*. You can get this document by calling 1-800-227-2345.

## Keep your health insurance and copies of your medical records

At some point after your cancer diagnosis and treatment, you may find yourself seeing a new doctor who does not know anything about your medical history. 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(s) from any biopsies or surgeries
- If you had surgery, a copy of your operative report(s)
- If stayed in the hospital, a copy of the discharge summary that doctors prepare when patients are sent home
- If you had radiation therapy, a summary of the type and dose of radiation and when and where it was given
- If you had chemotherapy, a list of your drugs, drug doses, and when you took them

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

## Lifestyle changes after malignant mesothelioma

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

### **Make healthier choices**

For many people, a diagnosis of cancer helps them focus on their health in ways they may not have thought much about in the past. Are there things you could do that might make you healthier? Maybe you could try to eat better or get more exercise. Maybe you could cut down on the alcohol, or give up tobacco. Even things like keeping your stress level under control may help. Now is a good time to think about making changes that can have positive effects for the rest of your life. You will feel better and you will also be healthier.

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

### **Eating better**

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

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

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

### **Rest, fatigue, and exercise**

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

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

Talk with your health care team before starting anything. Get their opinion about your exercise plans. Then, try to find an exercise buddy so you're not doing it alone. Having family or friends involved when starting a new exercise program can give you that extra boost of support to keep you going when the push just isn't there.

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

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

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

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

## **Can I lower my risk of the cancer progressing or coming back?**

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

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

## How does having malignant mesothelioma affect your emotional health?

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

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

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

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

## If treatment of malignant mesothelioma stops working

If cancer keeps growing or comes back after one kind of treatment, it may be 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. But when a person has tried many different treatments and the cancer has not gotten any better, the cancer tends to become resistant to all treatment. If this happens, it's important to weigh the possible limited benefits of a new treatment against the possible downsides, including treatment side effects. Everyone has their own way of looking at this.

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

If you want to continue to get treatment for as long as you can, you need to think about the odds of treatment having any benefit and how this compares to the possible risks and side effects. In many cases, your doctor can estimate how likely it is the cancer will respond to treatment you are considering. For instance, the doctor may say that more treatment might have about a 1 in 100 chance of working. Some people are still tempted

to try this. But it is important to think about and understand your reasons for choosing this plan.

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

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

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

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

## **What's new in malignant mesothelioma research and treatment?**

There is always research going on in the area of mesothelioma. Scientists are looking for ways to prevent, diagnose, and treat mesothelioma. Despite recent progress, much remains to be learned about the best way to treat these cancers.

### **Causes and prevention**

Much of the research on mesothelioma has focused on learning exactly how asbestos changes mesothelial cells and their DNA to cause these cancers. Understanding how these fibers produce cancer might help us develop ways to prevent those changes.

The role of asbestos in increasing the risk of mesothelioma is a definite public health concern. Researchers are learning more about which fibers can produce cancer, how they cause these cancers, and what levels of exposure can be considered safe. Now that the dangers of asbestos are known, we can limit or stop exposure in homes, public buildings, and the workplace. Unfortunately, regulations protecting workers from asbestos exposure are much less stringent in some countries than in others.

Research is also under way to clarify the role (if any) of SV40, a virus that has been linked to mesothelioma in some studies.

## Treatment

Mesothelioma remains a difficult cancer to treat, and doctors are constantly trying to improve on current approaches. The roles of surgery, radiation therapy, and chemotherapy in the treatment of mesothelioma are highly debated. Combinations of these treatments, called multimodality therapy, are now being studied and may provide the most promising option for some patients.

### **Chemotherapy**

Some chemotherapy drugs can shrink or slow the growth of mesotheliomas, but in most cases the effects last for a limited time. Several newer chemotherapy drugs, including raltitrexed, are currently being tested in clinical trials, together with other types of treatment.

As mentioned in the section "Chemotherapy," doctors are now exploring giving chemotherapy drugs directly into the chest or abdominal cavity, often right after surgery. In some cases the drugs are heated before they are given. Doctors hope that putting the drugs directly into contact with the tumors may allow them to work better, while limiting the side effects in the rest of the body.

### **Photodynamic therapy**

Another technique now being studied is photodynamic therapy (PDT). For this treatment, a light-activated drug is injected into a vein. The drug spreads throughout the body and tends to collect in cancer cells. A few days later (usually just after surgery for the mesothelioma), a special red light on the end of a tube is placed into the chest cavity. The light causes a chemical change that activates the drug and causes the cancer cells to die. Since the drug is only active in the areas exposed to the special light, this approach may cause fewer side effects than use of drugs that spread throughout all tissues of the body. Several clinical trials are now studying the use of PDT for mesothelioma.

### **Targeted drugs**

In general, chemotherapy drugs are limited in their effectiveness against advanced mesothelioma. As researchers have learned more about the changes in cells that cause cancer, they have been able to develop newer drugs that specifically target these changes.

Targeted drugs work differently from standard chemotherapy drugs. They often have different (and less severe) side effects.

One group of targeted drugs is known as angiogenesis inhibitors. These drugs target the growth of new blood vessels (angiogenesis), which tumors need to grow larger. Some of these drugs are already used to treat other types of cancer and are now being studied for use against mesotheliomas. Examples of these drugs include bevacizumab (Avastin<sup>®</sup>) and sorafenib (Nexavar<sup>®</sup>).

Other new drugs have different targets. For example, ranpirnase (Onconase<sup>®</sup>) is an enzyme that breaks down RNA (part of a cell's genetic material) and causes cancer cells to die at the right time. In early studies it has helped some patients with mesothelioma to live longer. Larger clinical trials are currently in progress.

Other new targeted drugs being tested in mesothelioma clinical trials include imatinib (Gleevec<sup>®</sup>), dasatinib (Sprycel<sup>®</sup>), bortezomib (Velcade<sup>®</sup>), and vorinostat (Zolinza<sup>®</sup>).

## **Gene therapy**

A newer type of treatment being tested on mesothelioma is gene therapy, which attempts to replace or repair defective genes in cancer cells. One approach to gene therapy uses special viruses that have been modified in the lab. The virus is injected into the pleural space and infects the mesothelioma cells. When this infection occurs, the virus injects the desired gene into the cells. Research on gene therapy is still in the early stages.

# **Additional resources for malignant mesothelioma**

## **More information from your American Cancer Society**

We have some related information that may also be helpful to you. These materials can be ordered from our toll-free number 1-800-227-2345.

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

Asbestos (also available in Spanish)

Caring for the Patient With Cancer at Home: A Guide for Patients and Families (also available in Spanish)

Clinical Trials: What You Need to Know (also available in Spanish)

Endoscopy

Living With Uncertainty: The Fear of Cancer Recurrence

Pain Control: A Guide for Those With Cancer and Their Loved Ones (also available in Spanish)

Surgery (also available in Spanish)

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

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

When Your Cancer Comes Back: Cancer Recurrence

The following books are available from the American Cancer Society. Call us at 1-800-227-2345 to ask about costs or to place your order.

*American Cancer Society Complete Guide to Complementary & Alternative Cancer Therapies*

*American Cancer Society Complete Guide to Nutrition for Cancer Survivors*

*American Cancer Society's Guide to Pain Control*

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

*Caregiving: A Step-By-Step Resource for Caring for the Person With Cancer at Home*

*What Helped Me Get Through: Cancer Patients Share Wisdom and Hope*

*What to Eat During Cancer Treatment*

*When the Focus Is on Care: Palliative Care and Cancer*

## National organizations and Web sites\*

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

### **Agency for Toxic Substances and Disease Registry**

Toll-free number: 1-800-232-4636

Web site: [www.atsdr.cdc.gov](http://www.atsdr.cdc.gov)

### **Environmental Protection Agency**

Telephone: 1-202-272-0167

Web site: [www.epa.gov](http://www.epa.gov)

### **Mesothelioma Applied Research Foundation**

Toll-free number: 1-877-363-6376 (1-877-END-MESO)

Web site: [www.curemeso.org](http://www.curemeso.org)

### **National Cancer Institute**

Telephone: 1-800-422-6237 (1-800-4-CANCER)

Web site: [www.cancer.gov](http://www.cancer.gov)

## **Occupational Safety and Health Administration**

Toll-free number: 1-800-321-6742 (1-800-321-OSHA)

Web site: [www.osha.gov](http://www.osha.gov)

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

No matter who you are, we can help. Contact us anytime, day or night, for information and support. Call us at **1-800-227-2345** or visit [www.cancer.org](http://www.cancer.org).

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1 · 800 · ACS-2345 or [www.cancer.org](http://www.cancer.org)