



## Lung Cancer Treatment

### Lung cancer overview

More than one in four of all diagnosed cancers involve the lung, and lung cancer remains the most common cancer-related cause of death among American men and women. In 2012, more than 160,000 lung cancer deaths occurred, outnumbering deaths from breast, prostate and colon cancers combined.

At the same time, it may well be that a great many lung cancers are preventable. Inhaling cancer-causing substances such as tobacco smoke may lead to changes in the lung tissue shortly after exposure — so-called precancerous changes. Nevertheless, cancer itself typically develops over a period of many years, and if detected at an early enough stage can often be treated successfully using a variety of treatments.

### What are my treatment options?

#### Pre-treatment evaluation

- Before treatment, a biopsy is usually performed to determine whether a patient has cancer, and if so, what type.
- Tests are recommended to determine the stage of the tumor. These tests usually include blood tests and imaging. The imaging usually includes computed tomography (CT) scanning of the chest, and may include a bone scan or a PET/CT scan. The treatment options and expected results of treatment depend on the stage of the tumor.

#### Treatment options overview

- About one-third of lung cancer patients are diagnosed with localized disease that may be treated by either surgical resection or, if the patient is not a candidate for full surgical resection, with definitive radiotherapy. Another third of patients have disease that has already spread to the lymph nodes. In these cases, radiation therapy along with chemotherapy and occasionally surgery is used. The last third of patients may have tumors that have already spread to other parts of the body via the blood stream and are typically treated with chemotherapy and sometimes with radiation therapy for the relief of symptoms.
- **Surgery** with removal of the entire lobe in which the tumor is located, is the primary treatment for patients with early-stage cancer who are in good general health. The goal of surgery is to totally

eliminate all the tumor cells and thereby provide a cure. Unfortunately, lung cancers tend to develop in smokers more than 50 years of age, who very often have other lung disease or serious medical conditions that magnify the risk of surgery. The location and size of a lung tumor dictate how extensive the operation must be. Open thoracotomy or less invasive video-assisted thoracic surgery, using smaller incisions, may be recommended for appropriately selected patients.

- **Lobectomy** — removal of an entire lobe of the lung — is an accepted procedure for removing lung cancer when the lungs are functioning well. The mortality risk is 3 percent to 4 percent, and tends to be highest in older patients. If lung function prohibits lobectomy, a small cancer confined to a limited area can be removed with a small portion of surrounding lung tissue. This is called a sublobar resection, and may be either a wedge resection or a segmentectomy. There is a possible higher risk of recurrence with more limited surgery than a lobectomy. Sublobar resections cause less loss of lung function, as a smaller portion of lung is removed, and carries an operative mortality risk of 1.4 percent. If the entire lung must be taken out by pneumonectomy, the expected mortality rate is 5 percent to 8 percent. The oldest patients are at highest risk and recurrent cancer is very common.

In a majority of cases, either the patient is not fit for surgery or it is not possible to remove the entire tumor because of its size or location.

- **Radiation therapy**, or radiotherapy, delivers high-energy x-rays that can destroy rapidly dividing cancer cells. It has many uses in lung cancer:

- As primary treatment
- Before surgery to shrink the tumor
- After surgery to eliminate any cancer cells that remain in the treated area
- To treat lung cancer that has spread to the brain or other areas of the body

Besides attacking the tumor, radiotherapy can help to relieve some of the symptoms the tumor causes such as shortness of breath. When used as an initial treatment instead of surgery, radiotherapy may be given alone or combined with chemotherapy. Today, many patients who have a small localized lung cancer, but who are not candidates for surgery, are being treated with a radiation treatment technique known as stereotactic body radiation therapy (SBRT). Patients who are poor candidates for surgery include the elderly, patients with chronic heart failure, and patients receiving a blood thinning drug that puts them at risk of surgical bleeding. SBRT involves treatment with a multitude of small, focused radiation beams tracking the lung tumor along with its respiratory movement, typically in three to five treatments. This treatment delivers very high doses of radiation therapy to the lung cancer in patients where surgery is not an option. SBRT is primarily used in the setting of early stage, localized disease. See the SRS and SBRT page for more information on SBRT.

Most often, radiation therapy is delivered by the external beam technique, which aims a beam of x-rays directly at the tumor. Treatment is given in a series of sessions, or fractions, usually over six to seven weeks for conventional treatments, and over one to five treatments for patients that can be treated with SBRT. For more detailed information see the External Beam Therapy (EBT) page. Three-dimensional conformal radiation therapy or intensity-modulated radiation therapy (IMRT) are fairly new techniques based on a 3-D image of the tumor taken with CT scanning. This image serves as the target for a high-dose radiation beam that can change in shape and size

to match the tumor. This method minimizes radiation exposure of nearby normal lung tissue. See the Intensity-Modulated Radiation Therapy (IMRT) page for more information.

In brachytherapy, radiation is delivered directly to the site of disease. This is usually achieved either through a surgical procedure where after resection of the primary tumor radioactive seeds are sutured to the edge of the surgical resection. Also, in the setting of an obstructive tumor within an airway, radiation is delivered to the site of obstruction through plastic tube that is temporarily inserted into the airway. This may help to relieve severe symptoms but does not cure the cancer.

- **Chemotherapy** involves drugs that are toxic to cancer cells. The drugs are usually given by direct injection into a vein or through a catheter placed in a large vein. Often given after surgery to sterilize microscopic disease, chemotherapy also may slow tumor growth and relieve symptoms in patients who cannot have surgery. Newer biologic agents, which may have fewer side effects than traditional chemotherapy and in some instances may be just as effective, are being used. This treatment is used in all stages of lung cancer and can prolong life even in elderly persons as long as they are in good general health. Some chemotherapy drugs increase damage done to tumors by the radiation treatment of cancer cells. Others keep the tumor cells at a stage where they are most susceptible to radiation treatment, or impair the ability of cancer cells to repair themselves after a course of radiation therapy. Evidence is mounting that a combination of these drugs integrated with radiotherapy is more effective than radiotherapy alone, but there is a substantial risk of serious side effects.

Chemotherapy may cause significant side effects, such as nausea with vomiting and damage to the white blood cells that are needed to combat infection, but there now are ways to counter and treat most of these effects.

## How does the treatment method depend on the type of lung cancer?

There are two main types of lung cancer that have different microscopic appearances:

- Small-cell lung cancer (SCLC)—also referred to as oat-cell cancer—usually is found in active or former cigarette smokers. Although SCLC is less common than the other type of lung cancer, it is a more aggressive tumor that is more likely to spread to other body sites. Chemotherapy is the mainstay of the treatment for SCLC. Radiation therapy is often used along with chemotherapy to treat lung tumors that have not spread beyond the chest or other organs. Surgery is not commonly used in SCLC due to its tendency to spread quickly. While surgery is seldom used to treat patients with SCLC, occasionally it is used to obtain tissue samples for microscopic study to determine the type of lung cancer present. For small cell lung cancer, after treatment directed to the disease in the chest, the radiation oncologist may suggest radiation therapy directed at the brain even though no cancer has been found there. This is called prophylactic cranial irradiation and is given to prevent lung cancer metastases from forming at this vital site.
- Non-small-cell lung cancer (NSCLC) tends to grow more slowly and takes longer to spread beyond the lung. Local treatments such as surgery and/or radiation therapy are the main-stay of treatment for NSCLC. If chemotherapy is used, it is often to increase the effectiveness of surgery or chemotherapy, and is generally different in NSCLC than in SCLC. Different types of chemotherapy may be used for different types of non-small cell lung cancer.

## How does the stage of disease guide lung cancer treatment?

### Small-cell lung cancer:

- For limited stage disease (confined to the chest), chemotherapy and radiation therapy are used as curative treatments.
- For extensive stage SCLC, chemotherapy alone is the mainstay of therapy.
- For limited or extensive stage, the radiation oncologist may suggest radiation therapy directed at the brain even though no cancer has been found there.
- For disease recurrence or disease that persists after initial treatment, radiotherapy or chemotherapy may help to reduce discomfort and pain. Radiotherapy or laser treatment can keep the airways open, allowing the patient to breathe more freely.

### Non-small-cell lung cancer:

- **Early Stage:** The earliest NSCLCs are very small tumors diagnosed after cancer cells are found in a sputum sample. Special tests may be needed to locate the main tumor. Early stage tumors are treated with surgery with or without chemotherapy or radiation therapy.
- **Advanced Stage:** Combined treatment is the rule when cancer has spread to structures near the lung, such as the chest wall, diaphragm or lymph nodes in the chest. Depending on the exact location of cancer, radiation therapy may be given alone or combined with surgery and/or chemotherapy.
- **Tumor that has spread to other parts of the body:** Surgery may be futile when cancer has spread to distant parts of the body. Chemotherapy or radiation therapy, alone or in combination, are usually relied upon to control symptoms in these patients. Laser treatment or brachytherapy may also be tried. The same measures are available to treat patients whose NSCLC has recurred, with one exception: surgery may be done to remove a very small amount of tumor that has spread to the brain.
- Any patient with lung cancer may want to consider taking part in one of the many clinical trials that are under way at any given time with the goal to find more effective treatments.

## How effective is treatment for inoperable lung cancer?

It is extremely important to remember that "inoperable" does not mean "incurable" when it comes to lung cancer. In fact, an increasing number of patients are being treated with a non-surgical approach across all stages of this disease. The effectiveness of the treatment depends on the stage of disease. In early stage inoperable disease that is treated with radiotherapy alone, control of disease is the norm. In more advanced disease, a combination of chemotherapy and radiation is delivered with curative intent. Cure rates are lower, but still possible even with disease spread to the lymph nodes within the chest. The medical or radiation oncologist may propose a combination of chemotherapy and radiation therapy for a patient who is normally active.

When cure is not a possibility, palliative treatment often is recommended. This is the use of medications, chemotherapy, radiation therapy or other measures to relieve symptoms of lung cancer without actually eliminating the tumor. The doses of radiation therapy used are smaller in order to avoid side effects. At some point, if you and your oncologist or primary care physician agree that active treatment no longer is advisable, hospice care can provide comfort and support. Pain relief is a very important part of treating lung cancer. Although many effective treatments are available and there are devices for delivering

medication on demand without overdosing, many cancer patients still do not receive adequate pain relief. If the needs of the patient are clearly expressed, the treating physicians can better provide appropriate care.

## What happens during radiation therapy?

Radiation therapy is the delivery of focused high-energy x-rays (photons), gamma rays or atomic particles. It affects cells that are rapidly dividing—such as cancer cells—much more than those that are not. Most cancers, including lung tumors, are made of cells that divide more rapidly than those in normal lung tissue, holding out the hope that the tumor can be eliminated without damaging surrounding normal tissues. Radiotherapy acts by attacking the genetic material—or DNA—within tumor cells, making it impossible for them to grow and create more cancer cells. Normal body cells may also be damaged—though less markedly—but they are able to repair themselves and function properly once again. The key strategy is to give daily doses of radiation large enough to kill a high percentage of the rapidly dividing cancer cells, while at the same time minimizing damage to the more slowly dividing normal tissue cells in the same area.

## What are possible side effects of radiation therapy?

- Most patients tire easily after receiving their first radiation treatments. This fatigue gradually increases as treatment continues and may become severe, seriously limiting the ability to engage in normal daily activities. Typically, fatigue lessens one to two months after radiotherapy is completed. If you experience fatigue it is important to get enough rest, but at the same time your physician may suggest that you stay as active as possible.
- Some patients experience hair loss in the area of the chest wall included in the radiation field. Depending on how much radiation is delivered, this may be temporary or permanent.
- Skin irritation is the rule after a few weeks of radiation therapy. The affected area may be reddened, dry, tender and itchy. This reaction can become quite severe during a long course of treatment. It helps to keep the skin clean with gentle soap and warm water, to dry it well and to avoid very hot water while bathing. A sunscreen should be used when skin in the treated area is exposed to sunlight. Perfumes, cosmetics and deodorants should not be used in the area of treatment. After daily treatments you may apply an unscented cream or lotion.
- Temporary loss of appetite is a possibility.
- Esophagitis, inflammation of the tube that conveys food from the mouth to the stomach, is common after radiotherapy for lung cancer and can be severe. The esophagus is very sensitive to radiation, and worse damage occurs in patients who also receive chemotherapy. Esophagitis makes it difficult to swallow and some patients have lost 10 percent or more of their body weight as a result. Nevertheless the inflammation settles within three weeks of completing treatment in most patients and shortly thereafter they begin to regain their lost weight.
- An inflammation of the lungs called radiation pneumonitis may develop three to six months after radiotherapy is over. It causes coughing and shortness of breath as well as fever but in most cases calls for no specific treatment and gets better within two to four weeks.

## What kind of treatment follow-up should I expect?

Once a course of radiotherapy comes to an end your physician usually will want to see you after six weeks and then every three months for the first two years. After this you may be seen every six months for three years and then once a year. Often your medical or radiation oncologist will recommend that you have a computed tomography (CT) scan or a positron emission tomography (PET) scan approximately six to eight weeks after completion of treatment, when the response is expected to be the greatest. These images will help to assess response and make it possible to do comparisons with images obtained in the course of follow-up. In this way treatment-related complications can be found at an early stage and it will be possible to tell the difference between recurrent cancer and lung scars produced by high-dose radiation treatment. By obtaining chest imaging on a regular basis, recurrent cancers may be discovered in time to be successfully re-treated.

In addition to x-rays, other tests such as blood cell counts and bronchoscopy may be a routine part of the follow-up exam, depending on whether symptoms are present. If new symptoms develop at another part of the body, tests may be done to detect any potential problem. Typical sites where cancers spread are checked by doing an MRI study of the brain, a bone scan, and a CT scan of the chest and upper abdomen.

Apart from recurrent tumor, a small amount of cancer may remain after treatment and begin to grow many months later. Or the finding of cancer during follow-up may mean a second primary lung tumor rather than a recurrence. Patients whose early-stage lung cancers are cured develop second cancers at a rate of at least 3 percent of patients per year. Here, too, frequent follow-up visits and chest x-rays provide the best chance of finding disease at an early, more treatable stage. A new method called fluorescent bronchoscopy uses a special light that is taken up by lung cancer cells and is able to detect very early cancers.

## Are there any new developments in treating my disease?

- Less invasive surgical methods are under study. They require a much smaller incision and allow the patient to be up within hours after surgery ends.
- Immunotherapy uses drugs that boost the patient's immune system to help control cancer. Some studies, but not all, have shown better survival rates when these drugs are given after surgery.
- Gene therapy may kill cancer cells or slow their growth when healthy genes are delivered directly into a lung tumor.
- Angiogenesis inhibitors are agents that prevent new blood vessels from forming in growing cancers and may actually turn off the tumor's blood supply. This remains an experimental approach but is promising in part because it seems to cause very few side effects.
- Genetic testing is being evaluated in order to select patients for appropriate treatment.
- Stereotactic Body Radiation Therapy (SBRT) can control early-stage tumors at a rate that is comparable to that achieved by surgery.

## Clinical Trials

For information and resources about clinical trials and to learn about current clinical trials being conducted, see:

- Clinical Trials - from RadiologyInfo's News section:
- Clinical Trials - from the National Cancer Institute's Web site:

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