

## Lung Cancer

### What is cancer?

First, some background on the way the body is built. Organs, like the heart, liver, and lung, are made up of tissues, such as blood vessels and muscle. Tissues, in turn, are made up of cells. Cells are the basic building blocks of tissue. Cancer results from the abnormal proliferation, or repeated divisions, of cells. The rapidly dividing cells of a cancer grow in number, developing into a tumor, or mass. A *lung* cancer develops when a group of cells in the lung begins dividing rapidly, and creates an enlarging mass within the lung. The size of the mass may double as quickly as every 30 days, or as slowly as every 400 days, depending upon the type of cells that are dividing, and on other factors. Different types of lung cancer originate from different types of cells. These different types of cells are identified by examining the cells under a microscope, and performing special tests on the cells. (1)

If not treated early enough, most lung cancers have a tendency to eventually spread to other areas of the body. The cancers can spread through the lymphatic system to the regional lymph nodes (tiny filters in the lymphatics), or through the blood, usually to bones or to the brain. The location of distant spread is called a metastasis. (1) The degree of spread of the cancer is known as the Stage of the lung cancer. The stages of lung cancer will be discussed below.

### Risk factors for lung cancer

The primary risk factor for lung cancer is cigarette smoking, and exposure to cigarette smoke.(2) 87% of patients with lung cancer have a history of tobacco exposure. The exposure can be either from smoking cigarettes, or from inhaling second hand smoke. The risk of lung cancer goes up with the number of cigarettes smoked per day, and the duration of use of tobacco. This is measured typically as pack-years, or the number of packs per day times the number of years of smoking.

Other risk factors for lung cancer include exposure to environmental agents such as asbestos and radon, (3) and exposure to other industrial products. Asbestos exposure is linked to a tumor of the pleura called mesothelioma. However, the combination of smoking and asbestos exposure generates a risk factor for lung cancer that is greater than the simple sum of the relative risks. Asbestos was used in the past as an insulation material, and in automobile brake pads, and was frequently used in shipyards. Radon is a naturally occurring gas, a byproduct of the breakdown of uranium. Radon can be found in up to 6 per cent of homes in the US. It is most frequently found in unventilated basements, and in concrete buildings. Home tests for radon are commercially available.

There are a number of other carcinogens (cancer causing agents) that are believed to be associated with lung cancer, and are reviewed elsewhere. (4)

### Incidence of lung cancer

Lung cancer is the most frequent cause of death from cancer in both men and women.(3) Lung cancer is responsible for more cancer deaths in men than all other cancers combined.(ibid.) In the late 1980's, the incidence of lung cancer in women surpassed the incidence of breast cancer due to the increasing use of tobacco by women.(ibid.)

The incidence of lung cancer can be reduced in large populations by reducing the use of cigarettes. In England, the lung cancer rate in men from ages 35 – 54 has dropped 50% in 30

years due to the development of non-smoking programs. (4) An individual can reduce his or her own risk by 50% by not smoking for 10 years.(5)

### **Symptoms**

Most patients early in the course of lung cancer have no symptoms. The cancer grows silently when it is very small. However, some patients will develop symptoms of a persistent cough, hemoptysis (coughing up blood), recurrent pneumonia, weight loss, wheezing, fever, or pain. Sometimes a lump develops in the neck or armpit. A few lung cancers secrete hormones or proteins that cause signs or symptoms.

By the time most lung cancers are discovered, 85% have spread beyond the ability of the surgeon to remove them.(3) Therefore, prevention, or early detection, when the cancer can still be removed, is important to obtain a cure.

### **Categories of lung cancer**

There are two general categories of lung cancer: small cell and non-small cell. The categories are divided this way because they act differently and are treated differently.

#### Small cell carcinoma

- One basic type
- Usually spreads early in the course
- Stages: limited or extensive
- Treated with chemotherapy

#### Non-small cell carcinoma

- Three basic types
  - Adenocarcinoma
  - Squamous cell carcinoma
  - Large cell carcinoma
- Usually spreads later in the course
- Stages: I, II, III, IV
- Treated with surgery, chemotherapy, and/or radiation therapy, depending on the stage.

### **Stages of Lung Cancer**

The amount of spread of a cancer in the lung is measured by its “stage.” The further that cancer cells have spread from the original mass, or the larger the cancer, then the higher the stage.

The stage of a cancer determines the treatment that is selected for that particular cancer, and the prognosis. The higher the stage, the greater the spread. The greater the spread, the worse the prognosis.

Non-small cell cancer is staged using the TNM staging system. TNM refers to T for tumor size, N for node status, and M for the presence or absence of metastases. In general, there are Stages I, II, III, and IV.

Stage I is a tumor that is localized to the lung, and has no lymph node involvement.

Stage II is a tumor that has lymph node involvement inside the lung only, or a tumor which has grown directly into another nearby structure, such as the chest wall.

Stage III is a tumor that has spread to the lymph nodes in the mediastinum (the center of the chest between the lungs.)

Stage IV is a tumor that has spread anywhere outside the confines of the chest. That is, tumor which has spread to the adrenal glands, bones, ribs, brain, or elsewhere.(6)

## **Diagnostic Studies**

The true diagnosis of lung cancer can only be made by looking at cells from a mass or lymph node under a microscope. There are a number of diagnostic tests that are performed in preparation or in pursuit of making a tissue diagnosis.

### Chest X-ray

The chest x-ray, also known as a chest radiograph or CXR, is a screening test for lung cancer. Many cancers are initially detected on a routine chest radiograph that is taken for an annual physical or in the process of evaluating another medical problem.

### CT scan of the chest

The CT scan is also known as a CAT scan, or computerized axial tomography. This scan takes only a few minutes to perform, and gives a very detailed image of the anatomy of the chest and lungs. It is used to evaluate the location and size of tumors in the chest, and is used to evaluate the size and location of lymph nodes in the chest. In addition, the adrenal glands are usually evaluated with this test, because the adrenal glands are an area where lung cancer can spread early in its course.

### PET scan

A PET scan is a test using injectable radioactive material which is detected by a special camera. The most frequent PET scan used for the lung measures the relative metabolism of glucose by tissues in the body. Infections, inflammation, and cancers use more glucose than surrounding tissues. This area of increased utilization of glucose appears to the camera as more intense radioactivity than surrounding areas on the scan (a "hot spot."). The PET scan is not perfect at predicting cancer. It only creates significant suspicion of cancer. In contrast, a PET scan that does *not* show increased activity in a lung tumor is very reliable. The chance of the nodule being a cancer in such a scan is very, very low.

### Bone Scan

A bone scan is a test using injectable radioactive material that is detected by a special camera. The bone scan is used to detect abnormal areas in the bones of the body. Sometimes these areas are abnormal due to arthritis or other changes, and sometimes due to spread of cancer to the bone. If an abnormality is detected by bone scan, then further investigation into the abnormal area may be necessary.

### Bronchoscopy

Bronchoscopy is a procedure done by Pulmonologists and Thoracic Surgeons. This procedure is done under sedation in a special area of the hospital or outpatient procedure suite. While the patient is sedated, a small, flexible tube is advanced through the nose or mouth into the windpipe (trachea). All of the visible branches of the windpipe (airways, or bronchi) are examined,

and biopsies of any abnormalities are performed. Sometimes biopsies of lung tumors are performed, and occasionally lymph node biopsies are done. The patient may return home on the same day of the procedure. Coughing up small amounts of blood for a few days after the procedure is not unusual.

#### CT directed needle biopsy

When a lung tumor is located far away from the airways, and cannot be reached by bronchoscopy and biopsy, another test may be performed. This test is performed by a Radiologist with the use of a CT scanner. The tumor is precisely located by using a CT scan. With the patient still in the CT scanner, local anesthesia (numbing medicine) is injected into the patient's skin. Then, a small needle is advanced directly into the lung tumor, and tumor cells are aspirated into a syringe, then examined under a microscope. In the vast majority of cases, there are no complications from a CT directed needle biopsy. Occasionally a small amount of air leaks from the lung into the chest, and the air must be removed by placing a small drain into the chest for several hours or a for a day.

#### Mediastinoscopy/Mediastinotomy/Chamberlain Procedure

Mediastinoscopy is an operation performed by a Thoracic Surgeon in a surgical suite with the patient under general anesthesia. Mediastinoscopy and the related procedures are used to evaluate the lymph nodes in the mediastinum, the center of the chest (media is derived from the Latin "medius" meaning the middle, or center.) For more detailed information, please see the related article on Mediastinoscopy.

The lymphatic vessels of the mediastinum carry lymphatic fluid from the lungs, returning the fluid to the venous system of the blood. This lymphatic fluid contains fluid and cells from the lung and pleura. The lymph nodes in the mediastinum serve as filters for lymph that leaves the lung. These filters act somewhat as a line of defense against the spread of cancer, trapping cancer cells, and preventing them from spreading further throughout the body. The lymph nodes will actually try to kill the cancer cells in some cases.

If cancer is present in the lymph nodes of the mediastinum, it means that the cancer has spread outside of the lung itself. The presence of cancer in the mediastinal lymph nodes makes the lung cancer a Stage III. Stage III lung cancers are usually treated with chemotherapy rather than surgery, with a few exceptions.

#### Thoracoscopy

Thoracoscopy is a surgical procedure done by a Thoracic Surgeon. The operation is performed under general anesthesia using a tiny endoscope, or fiberoptic camera, to look inside the chest. The surgeons of Thoracic Surgery Associates, PC, use a 5 mm endoscope, slimmer than a drinking straw, for this operation. With the use of special instruments, a biopsy of the lung, of the chest wall, or the mediastinal lymph nodes can be performed. Thoracoscopy can be used to help determine the stage of a cancer, and to treat some conditions associated with cancer, such as effusions, or pneumothorax. For more detailed information, please see the article on Thoracoscopy elsewhere in this site.

#### Thoracotomy

Thoracotomy is a surgical procedure done under general anesthesia by a Thoracic Surgeon. At Thoracic Surgery Associates, PC, we utilize an incision approximately six inches long, beneath the armpit, to go between the ribs and into the chest. This incision allows complete access to the chest to perform biopsies of the lung, the lymph nodes, or the chest wall. In addition, if necessary, a large section of the lung can be removed (a lobectomy.) For more detailed information, please see the article on Thoracotomy elsewhere in the site.

## **Treatment of Lung Cancer**

### Decision making

The decision regarding how a specific lung cancer is treated in a specific patient depends upon the cell type, the location, and the stage of the cancer. The collaboration of a medical oncologist, radiation oncologist, and thoracic surgeon gives the patient every possible option for treatment.

### Non surgical treatment

Stage III B and Stage IV cancers are almost always treated with chemotherapy, with or without radiation therapy. Surgery is not usually used for lung cancers that have spread outside the chest.

### Surgical treatment

Surgical removal of lung cancer is usually reserved for non-small cell lung cancer that is Stage I or II. There are a few Stage IIIA patients that will benefit from surgery. Stage IV patients with non-small cell lung cancer with a single brain metastasis in the presence of a single primary lung cancer may be candidates for surgery.

### Surgical techniques

#### Operations used for staging

Staging operations done by a Thoracic Surgeon. Such operations include:

- Bronchoscopy
- Mediastinoscopy
- Chamberlain Procedure
- Thoracoscopy
- Thoracotomy

These procedures are explained in detail elsewhere in the site.

#### Operations used for removal of a lung cancer

The removal of a lung cancer is done by a Thoracic Surgeon. The operation is called a thoracotomy and lobectomy. A six inch incision is made on the side or back of the chest, the large muscles of the chest wall are moved out of the way, and a space is developed between the ribs to gain access to the inside of the chest. The tumor mass is located in the appropriate lobe of the lung. The blood vessels leading to, and rising from, that particular lobe are ligated and divided. Then, the bronchus (airway, or breathing tube) to the lobe is divided, and the lobe, with the cancer and surrounding lymph nodes in it, is removed. For a more detailed description, please see the article elsewhere on the site.

### Risks of surgery

The immediate risks of surgery of the chest include bleeding (which could require blood transfusion), infection (which could require antibiotics or re-operation), and pneumonia. The risk of surgery increases with worsening lung function, worsening oxygen diffusion capacity, and age. In the immediate post-operative period, the patient is at risk for pneumonia (made worse by smoking, COPD, and chronic bronchitis), bronchitis, wheezing, and irregular heart beats. Patients

with chronic lung disease, heart disease, or kidney disease are at increased risk of surgery, or of worsening those conditions in the immediate post-operative period. Some rarer risks include the risk of hoarseness, development of a pulmonary hernia, and fluid collection under the skin (seroma.)

## Recovery from surgery

### In hospital

Most patients that have staging procedures go home on the day of surgery. Most patients that have thoracotomy lung resections stay in the ICU the night of surgery. If recovering well, the patient will be transferred to a surgical floor for the remainder of their stay. Most patients will have a heart monitor for most of their stay. Pain is controlled for the first few days with an epidural, and later with a patient-controlled analgesia pump. The usual length of stay after a thoracotomy is 5 to 7 days.

The rate of recovery is directly related to lung function and other related medical problems. Usually, the patient will get out of bed on the first post-operative day, and walk in their room the second day. By the third day, most patients should be able to walk in the halls.

Drains, called chest tubes, are left in place for 3 to 5 days to remove excess air and fluid from the chest after surgery. These drains are removed at the bedside when the drainage is sufficiently diminished, usually around the third to fifth day after surgery.

### At home

We encourage our patients to remain active at home after discharge. If the patient remains sedentary, they are at increased risk for pneumonia and for development of blood clots in the legs. Both of these conditions can require readmission to the hospital for a prolonged period of time.

The first week at home, we encourage the patient to walk around the house and the yard several times a day. The second week, the patient should walk around the block, or its equivalent, about a quarter of a mile a day. The third week, the patient should walk up to a mile a day, in parts, or at one time.

We restrict driving for three weeks, or later, until narcotic pain medicine is no longer needed.