



## Needle Biopsy of the Lung

Needle biopsy of the lung uses imaging guidance to help locate a nodule or abnormality and remove a tissue sample for examination under a microscope. A biopsy may be necessary when imaging tests cannot confirm that a nodule is benign, or a nodule cannot be reached by bronchoscopy or other methods. Needle biopsy is less invasive than surgical biopsy and may not require general anesthesia.

Tell your doctor about any recent illnesses or medical conditions and whether you have any allergies, especially to anesthesia. Discuss any medications you're taking, including herbal supplements and aspirin. You may be instructed not to eat or drink for eight hours prior to your procedure, and you will be advised to stop taking aspirin or blood thinner three days beforehand. Leave jewelry at home and wear loose, comfortable clothing. You may be asked to wear a gown.

### What is Needle Biopsy of the Lung?

A lung nodule is a relatively round lesion, or area of abnormal tissue located within the lung. Lung nodules are most often detected on a chest x-ray and do not typically cause pain or other symptoms.

Nodules or abnormalities in the body are often detected by imaging examinations. However, it is not always possible to tell from these imaging tests whether a nodule is benign (non-cancerous) or cancerous.

A needle biopsy, also called a needle aspiration, involves removing some cells—in a less invasive procedure involving a hollow needle—from a suspicious area within the body and examining them under a microscope to determine a diagnosis.

In a needle biopsy of lung nodules, imaging techniques such as computed tomography (CT), fluoroscopy, and sometimes ultrasound or MRI are often used to help guide the interventional radiologist's instruments to the site of the abnormal growth.

In a pleural biopsy, the pleural membrane, the layer of tissue that lines the pleural space between the lungs and the chest wall, is sampled.

### What are some common uses of the procedure?

Although more than half of single (called solitary) nodules within the chest are determined to be benign, these lesions are considered potentially malignant until proven otherwise, usually through a needle biopsy. In general, solitary lung nodules in children who have no history of cancer are much less likely to

be malignant.

When a nodule is detected, imaging tests may be performed to help determine if it is benign (non-cancerous) or malignant (cancerous). If imaging studies cannot clearly define the abnormality, a biopsy may be necessary.

When a physician orders a needle biopsy, the nodule is usually believed to be unreachable by other diagnostic techniques, such as bronchoscopy.

A pleural biopsy is performed when the cause for excess fluid in the pleural space cannot be determined by *thoracentesis*. The tissue sample removed from the pleural membrane during a biopsy is further analyzed for evidence of:

- tuberculosis
- cancer cells
- the presence of viral, fungal or a parasitic disease

## How should I prepare?

You may be instructed not eat or drink for eight hours before your biopsy. However, you may take your routine medications with sips of water. If you are diabetic and take insulin, you should talk to your doctor as your usual insulin dose may need to be adjusted.

Prior to a needle biopsy, you should report to your doctor all medications that you are taking, including herbal supplements, and if you have any allergies, especially to anesthesia. Your physician may advise you to stop taking aspirin or a blood thinner for a specific period of time before your procedure.

Also, inform your doctor about recent illnesses and other medical conditions.

You may be asked to wear a gown during the procedure.

Women should always inform their physician if there is any possibility that they are pregnant. Some procedures using image-guidance are typically not performed during pregnancy because radiation can be harmful to the fetus. See the Safety page for more information about pregnancy and x-rays.

You may want to have a relative or friend accompany you and drive you home afterward. This is necessary if you have been sedated.

## What does the equipment look like?

A biopsy needle is generally several inches long and the barrel is about as wide as a large paper clip. The needle is hollow so it can capture the tissue specimen.

There are several types of needles that may be used. Common ones include:

- A fine needle attached to a syringe, smaller than needles typically used to draw blood.
- A core needle, also called an automatic, spring-loaded needle, which consists of an inner needle

connected to a trough, or shallow receptacle, covered by a sheath and attached to a spring-loaded mechanism.

- A vacuum-assisted device (VAD), which uses a vacuum to aid in obtaining larger pieces of tissue.

Needle biopsies are often performed with the guidance of computed tomography (CT), fluoroscopy, ultrasound, or MRI.

## CT

The CT scanner is typically a large, box-like machine with a hole, or short tunnel, in the center. You will lie on a narrow examination table that slides into and out of this tunnel. Rotating around you, the x-ray tube and electronic x-ray detectors are located opposite each other in a ring, called a gantry. The computer workstation that processes the imaging information is located in a separate control room, where the technologist operates the scanner and monitors your examination in direct visual contact and usually with the ability to hear and talk to you with the use of a speaker and microphone.

## Fluoroscopy

The equipment typically used for this examination consists of a radiographic table, one or two x-ray tubes and a television-like monitor that is located in the examining room. Fluoroscopy, which converts x-rays into video images, is used to watch and guide progress of the procedure. The video is produced by the x-ray machine and a detector that is suspended over a table on which the patient lies.

## Ultrasound

Ultrasound scanners consist of a console containing a computer and electronics, a video display screen and a transducer that is used to do the scanning. The transducer is a small hand-held device that resembles a microphone, attached to the scanner by a cord. Some exams may use different transducers (with different capabilities) during a single exam. The transducer sends out high-frequency sound waves (that the human ear cannot hear) into the body and then listens for the returning echoes from the tissues in the body. The principles are similar to sonar used by boats and submarines.

The ultrasound image is immediately visible on a video display screen that looks like a computer or television monitor. The image is created based on the amplitude (loudness), frequency (pitch) and time it takes for the ultrasound signal to return from the area within the patient that is being examined to the transducer (the device placed on the patient's skin to send and receive the returning sound waves), as well as the type of body structure and composition of body tissue through which the sound travels. A small amount of gel is put on the skin to allow the sound waves to travel from the transducer to the examined area within the body and then back again. Ultrasound is an excellent modality for some areas of the body while other areas, especially air-filled lungs, are poorly suited for ultrasound.

## How does the procedure work?

Using imaging guidance, the physician inserts the needle through the skin, advances it into the lesion.

Tissue samples will then be removed using one of several methods.

- In a fine needle aspiration, a fine gauge needle and a syringe withdraw fluid or clusters of cells.

- In a core needle biopsy, the automated mechanism is activated, moving the needle forward and filling the needle trough, or shallow receptacle, with 'cores' of tissue. The outer sheath instantly moves forward to cut the tissue and keep it in the trough. This process is repeated several times.
- In a vacuum-assisted biopsy, the needle is placed into the site of abnormality. The vacuum device is activated, pulling the tissue into the needle trough, and then cutting it with the sheath. The tissue is then retracted through the hollow core of the needle. This procedure may be repeated several times.

## How is the procedure performed?

Imaging-guided, minimally invasive procedures such as needle biopsy of lung nodules are most often performed by a specially trained interventional radiologist.

Needle biopsies are usually done on an outpatient basis.

A nurse or technologist may insert an intravenous (IV) line into a vein in your hand or arm so that sedation or relaxation medication may be given intravenously during the procedure. You may be also given a mild sedative prior to the biopsy.

A local anesthesia will be injected to numb the path of the needle.

If the procedure is being performed with fluoroscopy, you will lie down or stand for the procedure.

If the procedure is performed with CT or MRI, you will lie down during the procedure. A limited CT or MRI scan will be performed to confirm the location of the nodule and the safest approach. Once the location of the nodule is confirmed, the entry site is marked on the skin. The skin around the insertion site will be scrubbed and disinfected, and a clean and sterile drape will be applied.

For nodules that are small and deep within the lung, or located near blood vessels, airways or nerves, CT allows better planning of the needle path for a safe biopsy.

CT-guided biopsies require patients to be able to hold still on the CT table for up to 30 minutes. Fluoroscopy and ultrasound allow real-time monitoring of the needle and are often easier for patients who have difficulty holding their breath.

Some imaging facilities may use general anesthesia or conscious sedation in young children who are unable to hold still. In this case the parent may be permitted to stay in the exam room until their child has fallen asleep. There may be a somewhat longer wait after the exam to be sure that the child is reasonably alert.

A very small nick is made in the skin at the site where the biopsy needle is to be inserted.

Using imaging guidance, the physician will insert the needle through the skin, advance it to the site of the nodule and remove samples of tissue. Several specimens may be needed for complete analysis.

After the sampling, the needle will be removed.

Once the biopsy is complete, pressure will be applied to stop any bleeding and the opening in the skin is

covered with a dressing. No sutures are needed.

You may be taken to an observation area for several hours. X-ray(s) or other imaging tests may be performed to monitor for complications.

This procedure is usually completed within one hour.

For a pleural biopsy, a hollow needle is placed through the skin on your back and into the chest cavity. When the needle reaches the chest wall, up to three samples of tissue are removed.

Tissue samples will then be removed using one of two methods:

- In a fine needle aspiration, a fine gauge needle and a syringe withdraw fluid or clusters of cells.
- In a core needle biopsy, the automated mechanism is activated, moving the needle forward and filling the needle trough, or shallow receptacle, with 'cores' of pleural tissue. The outer sheath instantly moves forward to cut the tissue and keep it in the trough. This process is repeated three to six times.

A pleural biopsy is usually completed within 30 to 60 minutes.

At the end of the procedure, the needle will be removed and pressure will be applied to stop any bleeding. The opening in the skin is then covered with a dressing. No sutures are needed.

A chest x-ray may be performed after the pleural biopsy to detect any complications.

## What will I experience during the procedure?

When you receive the local anesthetic to numb the skin, you will feel a slight pin prick from the needle. You may feel some pressure when the biopsy needle is inserted. The area will become numb within a short time.

You may be given a mild sedative prior to the biopsy, and sedation or relaxation medication may be given intravenously during the procedure if needed.

You will be asked to remain still and not to cough during the procedure. You also will be asked to hold your breath multiple times during the biopsy. It is important that you try to maintain the same breath-hold each time to insure proper needle placement.

Aftercare instructions vary, but generally your bandage may be removed one day following the procedure, and you may bathe or shower as normal.

You should not exert yourself physically (such as heavy lifting, extensive stair climbing, sports, etc.) the night of and for one full day following your biopsy. On the second day, if you feel up to it, you may return to your normal activities. If you are considering air travel soon after the biopsy, consult your radiologist.

You may experience some soreness at the biopsy site as the local anesthesia fades, but this should improve. You may also cough up a little blood, but this should be minimal. These symptoms will gradually fade over the 12 to 48 hours following the procedure.

Signs of a collapsed lung, which sometimes occurs following a needle biopsy of the chest, include shortness of breath, difficulty in catching your breath, rapid pulse (heart rate), sharp chest or shoulder pain with breathing, and/or blueness of the skin. If you experience any of these symptoms, go to the nearest Emergency Room and contact your physician as soon as possible.

## Who interprets the results and how do I get them?

A pathologist examines the removed specimen and makes a final diagnosis so that treatment planning can begin. Depending on the facility, the radiologist or your referring physician will disclose the results to you.

Your interventional radiologist may recommend a follow-up visit after your procedure or treatment is complete.

The visit may include a physical check-up, imaging procedure(s) and blood or other lab tests. During your follow-up visit, you may discuss with your doctor any changes or side effects you have experienced since your procedure or treatment.

## What are the benefits vs. risks?

### Benefits

- Needle biopsy is a reliable method of obtaining tissue samples that can help diagnose whether a nodule is benign (non-cancerous) or malignant.
- A needle biopsy is less invasive than open and closed surgical biopsies, both of which involve a larger incision in the skin and local or general anesthesia.
- Generally, the procedure is not painful and the results are as accurate as when a tissue sample is removed surgically.
- Recovery time is brief and patients can soon resume their usual activities.

### Risks

- Any procedure where the skin is penetrated carries a risk of infection. The chance of infection requiring antibiotic treatment appears to be less than one in 1,000.
- Bleeding.
- Coughing up blood (hemoptysis).
- An air leak from the punctured lung into the chest cavity that causes the lung to collapse (pneumothorax). If a collapsed lung should occur and is large enough to be considered harmful, a small tube may be inserted into the chest cavity to drain away the air. This tube is generally removed the next day. *See the Chest Tube Placement page for more information.*
- Women should always inform their physician or x-ray technologist if there is any possibility that they are pregnant. See the Safety page for more information about pregnancy and x-rays.
- This procedure may involve exposure to x-rays. However, radiation risk is not a major concern

when compared to the benefits of the procedure. See the Safety page for more information about radiation dose from interventional procedures.

## What are the limitations of Needle Biopsy of Lung Nodules?

In a small number of cases, the tissue obtained during a biopsy may not be adequate for diagnosis.

Needle biopsy is not cost-effective for small lesions one to two millimeters in diameter. Nodules this small cannot provide enough tissue for an accurate diagnosis and are also too difficult to target.

For patients with certain conditions associated with emphysema, lung cysts, blood coagulation disorder of any type, insufficient blood oxygenation, pulmonary hypertension, and certain heart failure conditions, a needle biopsy may not be recommended. In these situations, your physician and the physician performing the biopsy will work together to help decide the best course of treatment.

Alternatives to lung biopsy usually include continued follow-up with imaging and surgical removal of the abnormality.

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