

# 20 Lungs

## General Comments

Pathologists are routinely called on to process a diverse spectrum of lung specimens, ranging in size and complexity from minute biopsies to pneumonectomies. Despite this diversity, these specimens can be systematically approached by keeping in mind the five basic components of the lung specimen: the airways, the lung parenchyma, the pleura, the vessels, and the lymph nodes.

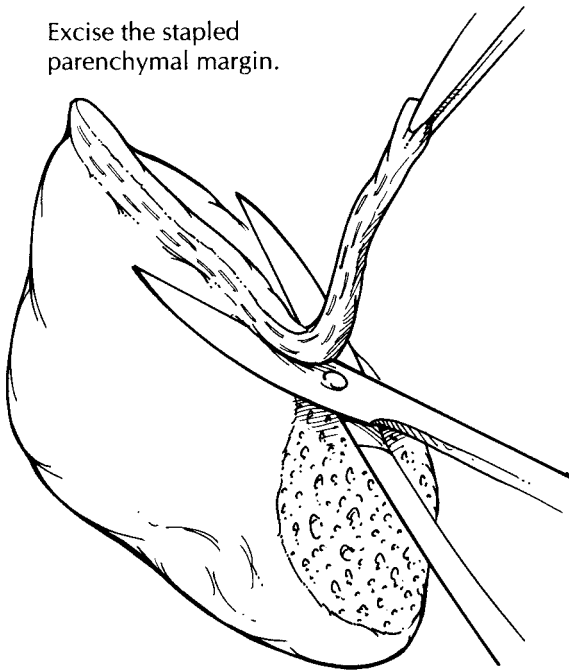
Before beginning the dissection, be sure to ask yourself two questions: First, does the pathology need to be revealed immediately? For example, if an infection is suspected, cultures may have to be taken from fresh tissues in a sterile fashion. Likewise, in the case of a suspected neoplasm, frozen section evaluation may be required to establish a diagnosis or to assess resection margins, and sampling of fresh tissue may be needed for ancillary diagnostic studies, such as electron microscopy. Next, ask which method of dissection will most effectively reveal the pathologic process and best demonstrate the relationship of the disease to the surrounding lung and pleura. There is more than one way to dissect a lung, and the method of sectioning is often dictated by the type of specimen, the suspected nature of the pathologic process, and the size and location of the pathologic process. Clearly, the more clinical information that is available, including radiographic findings, the more effectively these questions can be answered. Finally, keep in mind that a wealth of information can be obtained simply by palpating the intact specimen. Even small focal lesions can be appreciated by palpation, and this fast and easy method of examination should

become a routine part of the initial evaluation of any lung resection.

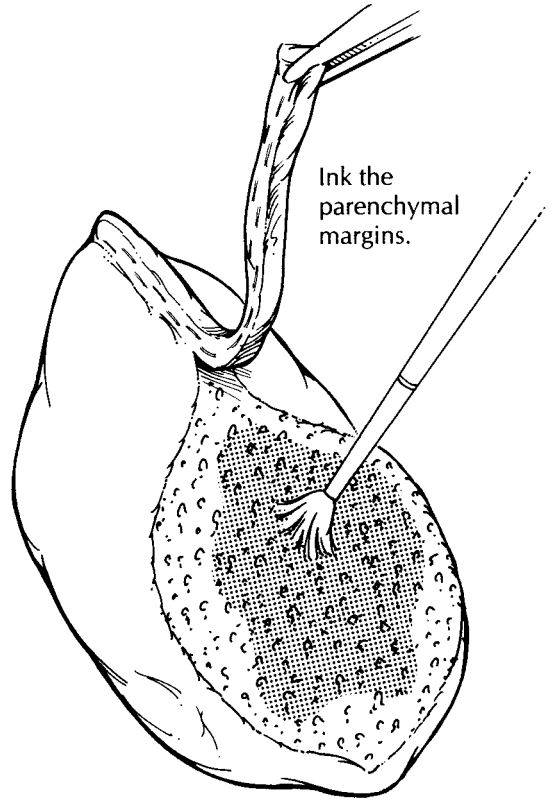
## Limited Pulmonary Resections

Limited pulmonary resections include open lung biopsies and wedge resections for both neoplastic and non-neoplastic diseases. These specimens are generally taken from the periphery of the lung. As illustrated, they usually are wedge-shaped pieces of lung tissue invested by visceral pleura. Because of their small size and peripheral location, lymph nodes and major bronchi are usually not present. Surgical staple lines may be present, and these represent the parenchymal resection margins. Document the dimensions of the specimen and the appearance of the pleural surface. If clinically indicated, fresh tissue can be harvested for microbial cultures and for immunofluorescence. If immediate dissection is not required, however, fix the specimen before proceeding with the dissection. Fixation in distention can be accomplished by gently infusing formalin directly into the lung parenchyma at several sites through a small-gauge needle. Take care not to overdistend the specimen. Submerge the distended specimen in formalin until it is well fixed. Following fixation, trim the staple lines from the specimen. Be careful not to remove too much lung tissue with these staples, because the exposed lung parenchyma immediately adjacent to the staples represents a surgical margin. Dry and ink the exposed parenchymal margin, and then serially section the specimen in a plane perpendicular to that of the parenchymal resection margin.

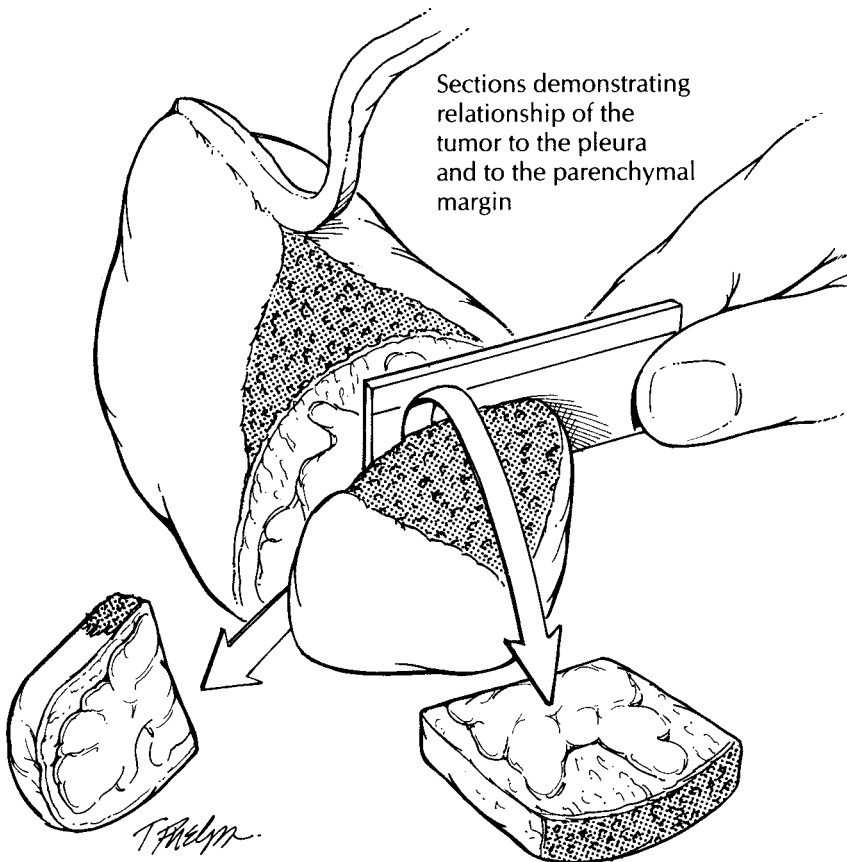
Excise the stapled  
parenchymal margin.



Ink the  
parenchymal  
margins.



Sections demonstrating  
relationship of the  
tumor to the pleura  
and to the parenchymal  
margin



### Wedge Resection

1. Remove the staple line.
2. Ink the parenchymal margin.
3. Section the lung parenchyma perpendicular to the resection margin, document the size of the tumor, and measure the distance from the edge of the tumor to the resection margin.
4. Submit sections of the tumor to demonstrate its relationship to the parenchymal margin and to the pleura. Submit sections of non-neoplastic lung.

After sectioning the specimen, evaluate the lung for focal and diffuse processes, and describe these findings. For neoplasms, note the size of the tumor, the appearance of its cut surface, and the relationship of the tumor to the pleura and to the surrounding lung parenchyma. Note also the distance from the edge of the tumor to the resection margin. Submit one to four sections of the lesion (depending on its size), selecting sections that demonstrate the tumor's relationship to the pleura, to adjacent lung tissue, and to the parenchymal resection margin. Sample the parenchymal margin, using perpendicular sections when the tumor closely approaches the margin. In addition, submit two sections of non-neoplastic lung. Intrapulmonary lymph nodes and bronchi will generally not be present in these peripheral lung biopsies, but if they are present, they should be sampled.

For non-neoplastic lung diseases, submit the vast majority of the specimen for histologic evaluation. In selected instances, a representative section should be fresh-frozen, especially if immunofluorescence studies are needed to establish a diagnosis. Note the size of the airspaces, the patency of any airways that are present, and the crepitation of the parenchyma. Only rarely should intraoperative frozen section consultations be performed for non-neoplastic lung disease.

## Lobectomies and Pneumonectomies

The largest lung specimens consist of lobectomies and pneumonectomies. These procedures are usually done to remove neoplasms, although pneumonectomies for non-neoplastic lung disease are encountered in some medical centers performing lung transplantations (see Chapter 21). When a tumor directly invades beyond the pleura, these specimens may also include an en bloc resection of the involved adjacent structures (e.g., chest wall, left atrium, or diaphragm).

Weigh, measure, and anatomically orient the specimen while it is fresh. One quick and easy way to orient the specimen is to inspect the structures at the lung hilum. On the left side the pulmonary artery is situated superior to the airway, while on the right side it is situated anterior to the airway. Also, the right side has three lobes, whereas the left side has two and a prominent

lingular segment. Carefully inspect the pleural surfaces. Look for the presence of pleural retraction, because this finding suggests the presence of an underlying neoplasm. Palpate the intact specimen: Is the tumor located centrally or peripherally? Which lobe of the lung appears to be involved? Does the tumor extend across a fissure to involve more than one lobe?

The lung may be processed in either the fresh or the fixed state. If immediate dissection of the specimen is not required, it is best to fix the specimen in distention. Infuse formalin directly into the large airways, and submerge the entire specimen in formalin for overnight fixation. Take care not to overdilate the lung.

If you remember each of the five basic components of the lung (airways, lymph nodes, vessels, parenchyma, and pleura), then your description and dissection can be carried out in a simple and systematic fashion. Many proximal lung tumors arise from the airways, and so we find it most helpful to start the dissection with the airways. Begin by removing the bronchial and vascular margins as shave sections. Next, expose the bronchial mucosa by opening the large airways out to the subsegmental branches with small scissors. Carefully examine the mucosa of the airways, because subtle changes in the appearance of the mucosa may indicate a premalignant lesion. Similarly, open the large pulmonary vessels and evaluate them for invasion by tumor.

By dissecting the larger airways, you have opportunely exposed the regional lymph nodes, and these should be sampled at this time. Direct the search for lymph nodes to the soft tissues at the hilum and to the lung parenchyma immediately surrounding the airways. Lymph nodes are often easily visualized by their black (anthracotic) pigmentation. It is generally not necessary to further designate these peribronchial lymph nodes. The status of the various mediastinal lymph node groups is crucial to the staging of lung tumors. These lymph node groups are usually separately submitted and labeled by the surgeon, although pneumonectomies may be accompanied by attached hilar lymph nodes. Such lymph nodes should be identified by their location in the hilum of the lung and specifically designated "hilar lymph nodes."

Section the lung parenchyma in the plane that best reveals the pathologic process and its relationship to the surrounding structures of the lung. For proximal lung tumors, this relationship

can best be demonstrated by sectioning the lung along the plane of the involved airways. As illustrated, this can be accomplished by first placing probes into the airways that have already been partially opened and then using these probes to help guide your knife through the lung parenchyma. In this manner, one can determine the origin and size of proximal tumors and evaluate the lung parenchyma distal to the tumor. The remaining lung parenchyma can then be sectioned at 1-cm intervals. For peripherally located tumors, a site of origin from an airway may not be apparent. In these instances, serial sections through the tumor perpendicular to the closest segmental bronchus may best reveal the relationships of the tumor to the pleura, to the surrounding lung parenchyma, and to the small airways.

For non-neoplastic lung diseases, section the specimen in a manner that best correlates with the radiographic studies. For example, thin serial sections of the fixed specimen in the transverse plane can be used to arrive at a one-to-one correlation between changes identified in computed tomography scans and the pathology. In the description of these large lung specimens, do not lose sight of the systematic approach that includes descriptions of all five basic components of the lung.

For specimens that harbor a neoplasm, the major aims of tissue sampling for histology are to document the tumor type, the origin of the tumor, the extent of the tumor (local and metastatic), and the adequacy of tumor resection. To assess tumor type, submit four sections of tumor, both from the center of the tumor and from the interface of the tumor with the surrounding lung tissue. Make every effort to demonstrate the relationship of the tumor to an associated airway. For more proximal tumors with an apparent endobronchial component, take sections along the involved airway to include both tumor and bronchus. For peripheral lesions, a site of origin from a small airway may not be apparent. In these cases, take sections through the tumor in a plane perpendicular to the airways. Document tumor extension to or through the pleura with sections taken at right angles to the pleura in areas of retraction. Similarly, take sections of tumor extension into the pulmonary vessels, hilar soft tissues, and chest wall. Submit all lymph nodes identified in the hilar and peribronchial regions. If the specimen also contains a portion of chest wall, take sections and margins from all

of the attached structures (parietal pleura, skin, soft tissues, and ribs), as if this block were its own specimen. Finally, submit sections of non-neoplastic lung from each lobe, including sections taken distal to the tumor for documentation of an obstructive pneumonic process.

For diffuse non-neoplastic processes, submit representative sections of lung parenchyma from each lobe as well as sections of proximal airways. If a focal lesion is encountered, section it in the manner described above for a neoplasm.

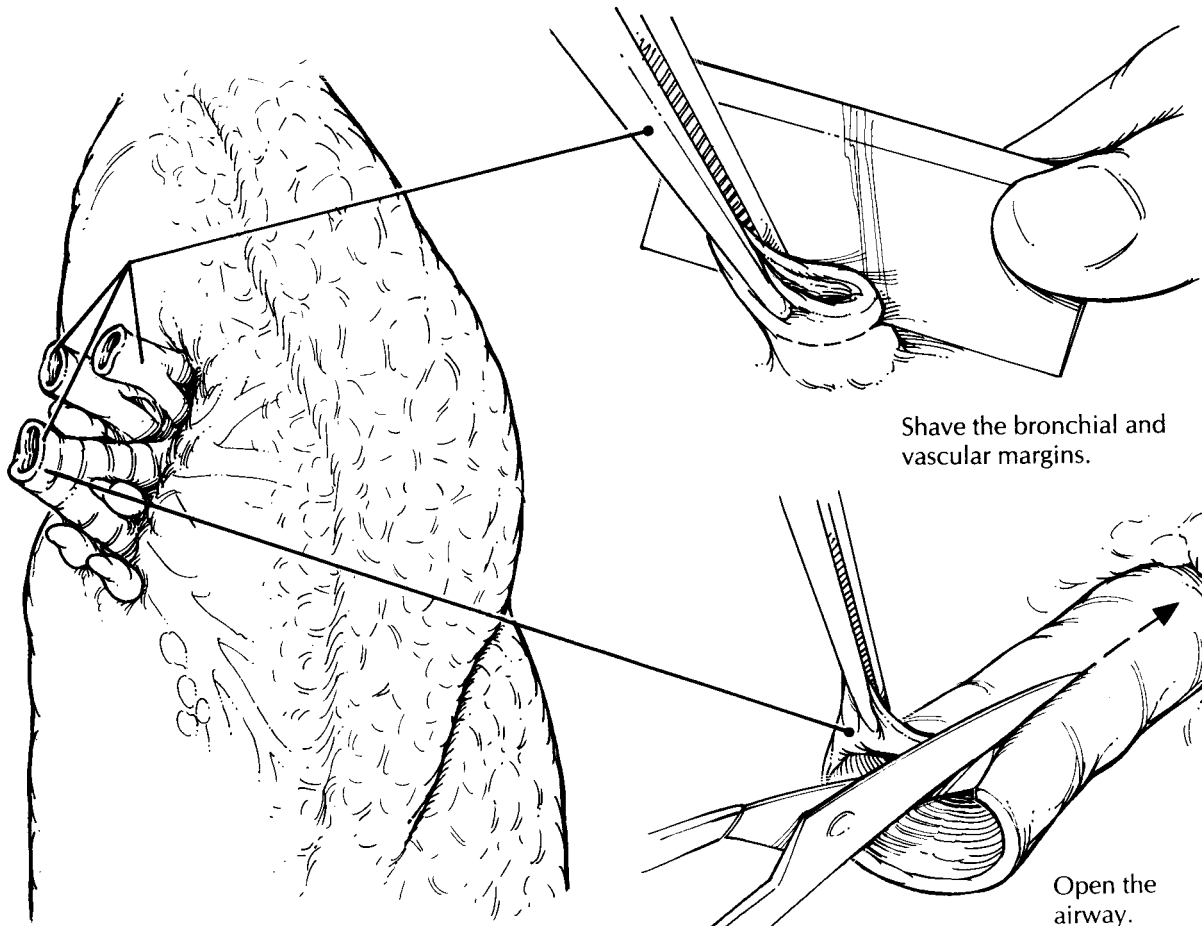
## Pleural Resections for Malignant Mesotheliomas

The diagnosis of malignant mesothelioma is usually established on the basis of cytologic material or small incisional biopsies. Rarely, malignant mesotheliomas are resected in an attempt to obtain a surgical cure. For tumors arising in the chest, these specimens generally consist of lung with en bloc removal of any adjacent involved mesothelium-lined structures such as the parietal pleura of the chest wall, the pericardium, and the diaphragm. These specimens can generally be handled using the same principles guiding the dissection of other lung specimens, as detailed above. When it comes to malignant mesotheliomas, however, a few points warrant special emphasis.

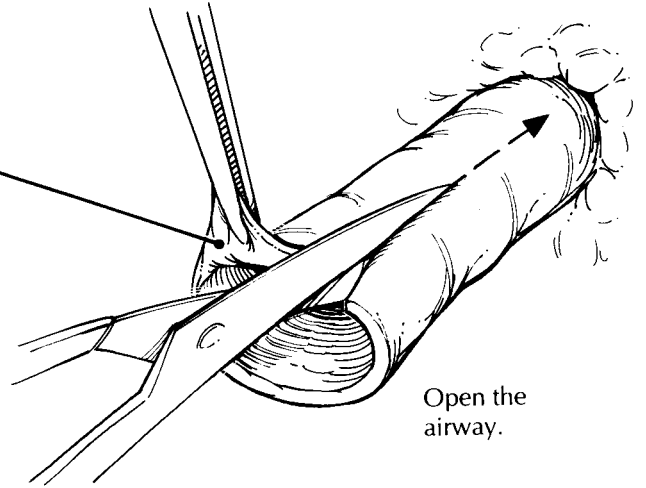
1. Immunohistochemistry and electron microscopy have become important adjuncts to routine microscopic evaluation in the diagnosis and classification of malignant mesothelioma. For lung specimens with pleura-based tumors, always consider the possibility of a malignant mesothelioma, and process a small portion of the tumor for electron microscopy should this modality be needed to establish the diagnosis.

2. Because of the variable and sometimes deceptively bland histopathologic appearance of malignant mesotheliomas, the diagnosis and classification are aided by ample sectioning for histologic evaluation. Suspected malignant mesotheliomas should be sampled much more extensively than the conventional lung carcinoma. For smaller lesions, submit the tumor in its entirety. For large lesions, submit at least one section per centimeter of tumor.

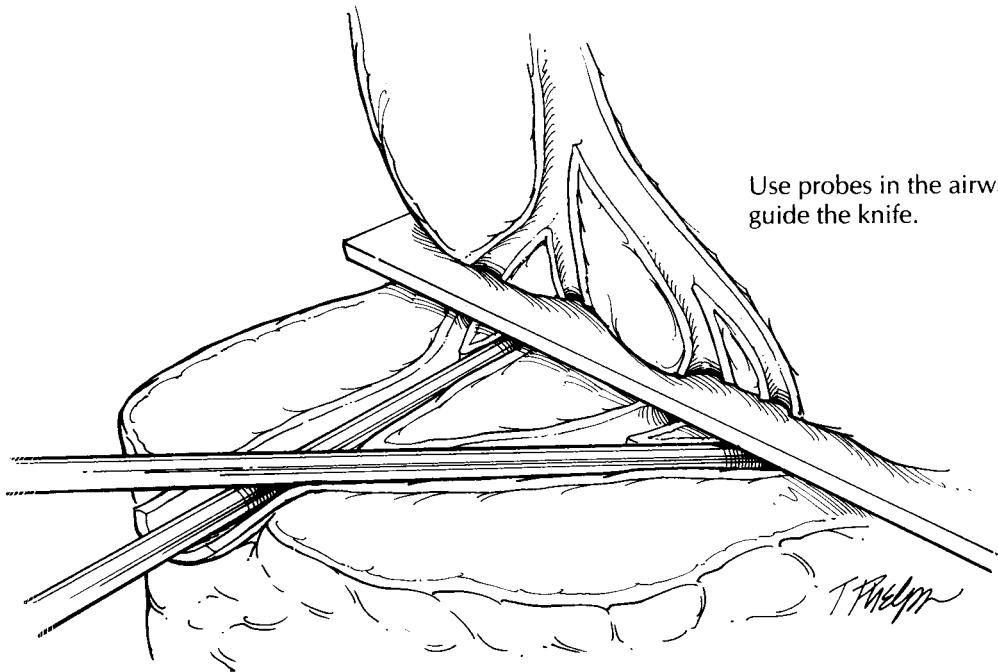
3. Depending on the extent of tumor involvement along mesothelium-lined surfaces, these resections may be anatomically complex. Do not



Shave the bronchial and vascular margins.

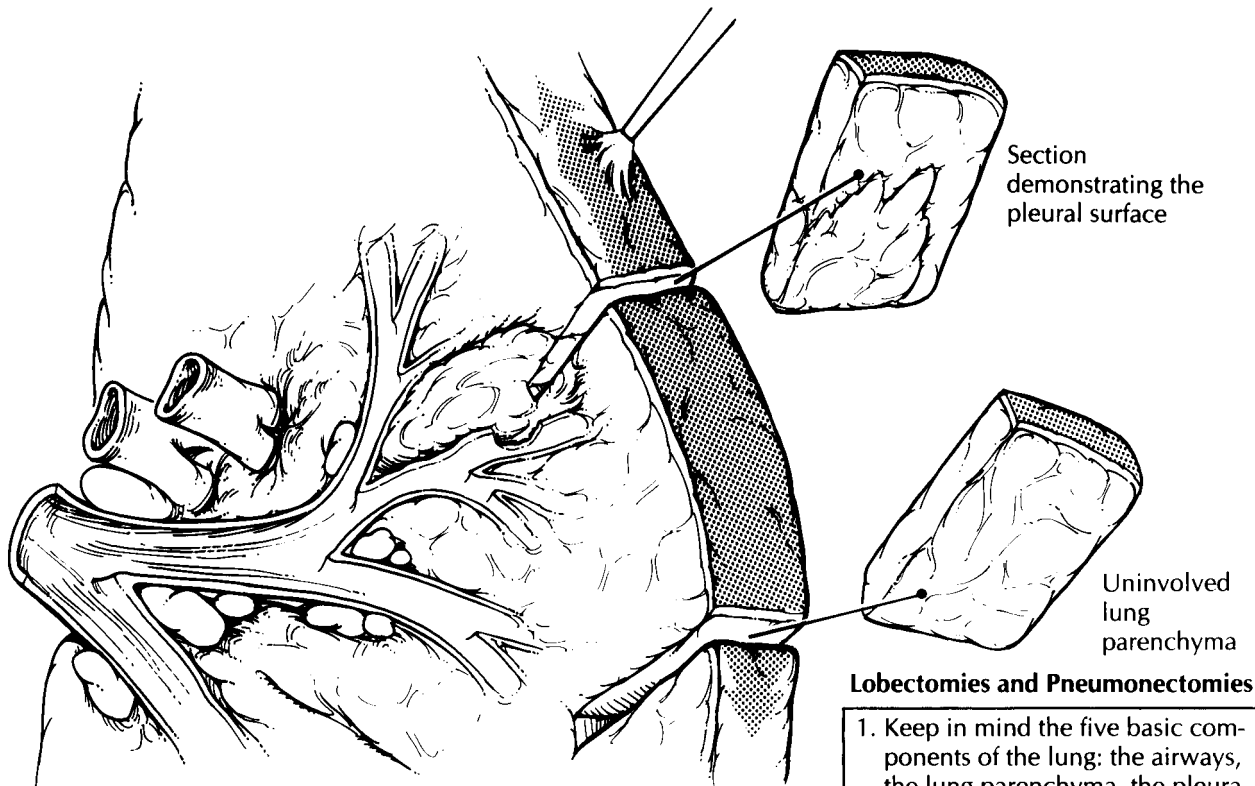


Open the airway.



Use probes in the airway to guide the knife.

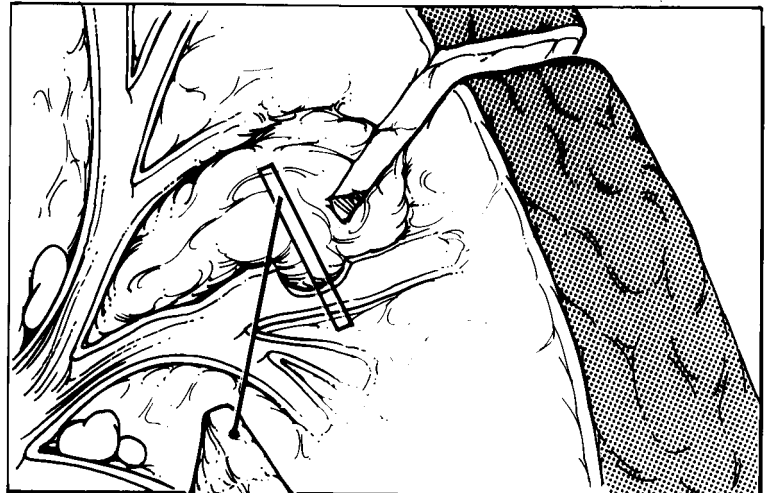
*T. Phelan*



Section demonstrating the pleural surface

Uninvolved lung parenchyma

**Lobectomies and Pneumonectomies**



*T. Pichler*



Section showing the relationship of the tumor to the airway

1. Keep in mind the five basic components of the lung: the airways, the lung parenchyma, the pleura, the vessels, and the lymph nodes.
2. Orient the specimen using the hilum of the lung. On the left side, the pulmonary artery is situated superior to the airway.
3. Shave the bronchial and vascular margins.
4. For pneumonectomies, identify and designate the hilar lymph nodes and submit for histologic evaluation.
5. Open the airways, and section the lung parenchyma in the plane that best demonstrates the pathology.
6. If a tumor is present, document its size and its relationship to each of the five basic components of the lung.
7. Dissect lymph nodes from the peribronchial regions.
8. Submit the bronchial and vascular margin sections, a perpendicular section of the pleural margin, and sections to demonstrate the relationship of the tumor to the pleura, airways, and vessels. Submit sections of the adjacent grossly uninvolved lung parenchyma and each lymph node.

rush through the dissection. Instead, take the time necessary to orient the specimen, identify all structures present, document the extent of tumor spread, and locate each margin (e.g., bronchus, pulmonary vessels, chest wall, diaphragm) for histologic evaluation.

4. Submit additional sections of uninvolved lung, and evaluate them for the presence of ferruginous bodies, pleural plaques, and interstitial fibrosis.

### **Important Issues to Address in Your Surgical Pathology Report on Lung Resections**

- What procedure was performed, and what structures/organs are present?
- Is a neoplasm present?
- How large is the tumor, and where is it located?
- What are the histologic type and grade of the tumor?
- Does the tumor infiltrate the large airways, pleura, or vessels?
- What is the status of each of the margins (parenchymal, vascular, and bronchial)?
- Does the tumor involve the lobar or main-stem bronchi?
- Is there any evidence of metastatic disease? Record the number of lymph nodes examined and the number of lymph node metastases. If nodal involvement is only by direct extension, this feature should be noted.
- Is there any pathology in the non-neoplastic lung (e.g., granulomas, postobstructive pneumonia)?