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## Introduction

Bronchiectasis is a permanent dilation of the subsegmental bronchi (>2 mm in diameter) mainly secondary to an infectious process. A congenital form may be observed, but most cases are acquired. Childhood diseases such as pertussis, measles, and herpesvirus infections are responsible for many cases. Repeated bacterial respiratory tract infections with *Klebsiella* species, *Staphylococcus aureus*, or *Mycobacterium tuberculosis* also may cause bronchiectasis in adults (Miller 2009). Bronchial obstructions by endoluminal tumors, hilar lymph nodes, or foreign body aspiration are other factors that cause bronchiectasis. Because the middle lobe bronchus is thin, its obstruction by lymph nodes enlarged by several conditions may lead to chronic infection. This kind of bronchiectasis is termed *middle lobe syndrome* (Einarsson et al. 2010). Cystic fibrosis (CF) is the primary cause of bronchiectasis in developed countries. In contrast to the localized form in postinfectious and postobstructive diseases, bronchiectasis in CF generally exists in both lungs in a disseminated form. Other rare forms of bronchiectasis may be seen in allergic bronchopulmonary aspergillosis, primary ciliary dyskinesia,  $\alpha_1$ -antitrypsin deficiency, congenital and acquired immunodeficiency states, intralobar or extralobar sequestrations, and sarcoidosis.

A history of frequent bronchopulmonary infections and continuous sputum production is usually present. Bloodstained sputum is not infrequent; however, major hemoptysis is rare. Malodorous breath also may be observed in most patients. All these conditions tend to socially isolate the patient, leading to an unsuccessful educational life or professional career. Localization of bronchiectasis is closely

related to the underlying cause. Postinfectious forms are most commonly observed in the left lower lobe and lingular segment, whereas tuberculosis bronchiectasis often appears in the right upper lobe (Doğan et al. 1989). The left upper lobe rarely is affected unless the disease is disseminated, as seen in CF. Middle lobe localization is generally isolated, as in middle lobe syndrome, but sometimes is associated with other lobes or segment bronchiectasis, as seen in foreign body aspiration. Whole lung bronchiectasis, which is a different entity termed *destroyed lung*, is more common in the left side (Halezeroğlu et al. 1997).

Diagnosis is generally not difficult in patients presenting with a typical history. Classical CT may show the bronchiectasis area, but the extent of the disease can be seen best by high-resolution CT (HRCT) (Pasteur et al. 2010), which is decisive in all cases in which surgical treatment is anticipated. Bronchoscopy is performed to rule out endobronchial obstruction by tumor or foreign body. Bacteriologic culture of the sputum is helpful for selecting the most appropriate antibiotic(s) in all patients, including those who will undergo surgical resection.

Selection of treatment depends on several factors, such as the underlying cause (i.e., infection, obstruction, or immunodeficiency), the duration of complaints, the frequency of symptoms (i.e., how many times a year antibiotic treatment is necessary), a localized or disseminated existence, the presence of hemoptysis, social conditions (i.e., presence of frequent breaks in work or education), and the patient's functional capacity (Miller 2009). Medical treatment with antibiotic(s), postural drainage, recommendations to avoid infections, cessation of smoking, and vaccination comprise the initial management in all patients. Before proceeding with surgery, this treatment should be repeated at least three or four times and continued for at least 2 years unless a severe complication, such as major hemoptysis requiring prompt surgical intervention, arises. Lung transplantation also has been reported in patients with bronchiectasis due primarily to CF.

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Surgical resection is considered for patients with localized, postinfectious, or postobstructive bronchiectasis in whom medical therapies have failed (Miller 2009).

Lobectomy and/or segmentectomy are performed in most patients, whereas pneumonectomy is necessary when bronchiectasis causes a destroyed lung (Halezeroğlu et al. 1997).

### Figure 23.1

A lateral thoracotomy incision is made, and the thorax is entered through the sixth intercostal space for lower lobe and the fifth intercostal space for middle or upper lobe bronchiectasis. The parietal pleura is mildly or moderately thickened and attached to the lungs and chest wall. An extrapleural area is created first by blunt dissection, and the intercostal space is enlarged by using two rib spreaders for better exposure. The parietal pleura is held by two long clamps; the lung is palpated underneath, and the pleura is opened carefully with a scissor. The index finger is advanced through the hole in the parietal pleura to detach the visceral pleura gently, without injuring the lung. Subsequently, the parietal pleura is cut with the scissor to sufficiently expose the lobes. The diseased lobe becomes smaller and attaches firmly to the diaphragm and moderately to the chest wall, pericardium, aorta, and other lobe(s), depending on its anatomic location (lower or upper lobe and right or left side). In the most commonly observed location, the left lower lobe, the release of the bronchiectatic lobe starts from the surface

of the descending aorta after the thoracic wall attachment is separated by blunt and sharp dissection. Generally, the aortic adventitia prevents firm invasive adhesions, making blunt separation of the lobe by hand safe. Dissection is performed by positioning the backside of the hand over the aorta while two or three fingers create a cleavage under the lobe and over the aorta. The thumb feels the fingers where the lobe attaches to the chest wall lateral to the aorta, and this attachment is released mainly by finger dissection and partly by sharp dissection to the diaphragm. The inferior surface of the lung is firmly attached to the diaphragm so that a border between the lung and diaphragm cannot be recognized easily. Therefore, dissection by the fingers from below is preferred to avoid tears in the muscle of the diaphragm. Surface bleeding is common during aortic and diaphragmatic dissection and controlled best by warm towel compressions. Releasing from the pericardium and fatty tissue is performed mainly by the energy-based ligation method or electrocautery

### Figure 23.2

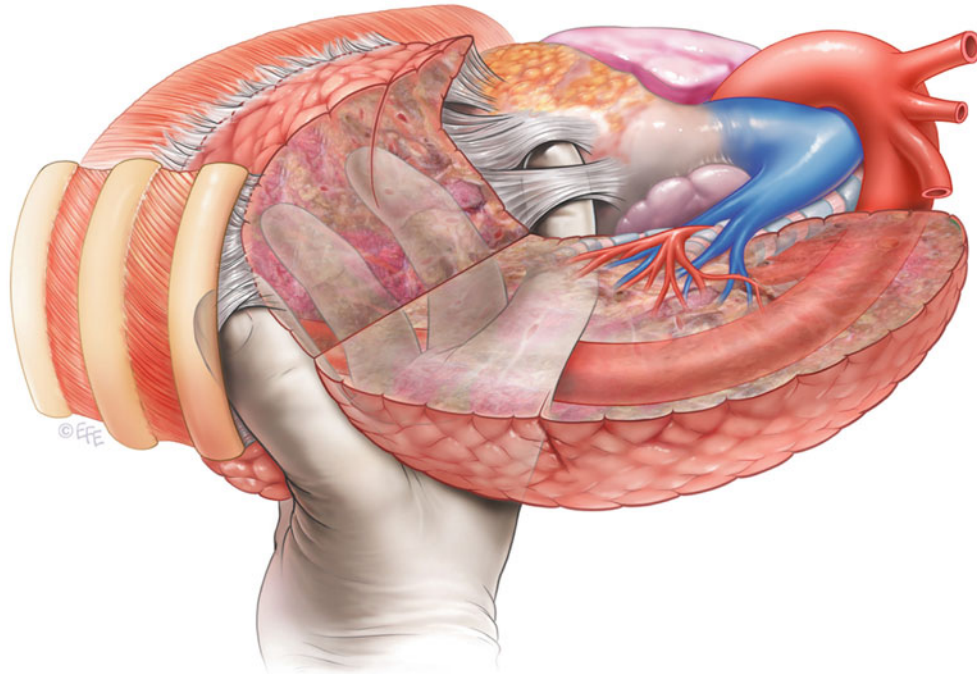
When there is a firm symphysis between the lobes as a result of chronic inflammation, a sharp separation process may cause tears in the healthy lung that are associated with prolonged postoperative air leak. Therefore, a 3- to 4-mm tunnel is created first by a blunt, pointed, long-curved dissector from just inferior to the superior pulmonary vein to the

lateral side of the lower lobe bronchus. Then, one arm of a linear stapler is passed through this hole, the lobes are grasped with lung clamps, the other foot of the stapler is placed over the lung on the border between the fibrotic and healthy lobes, and stapling is completed to separate the lobes

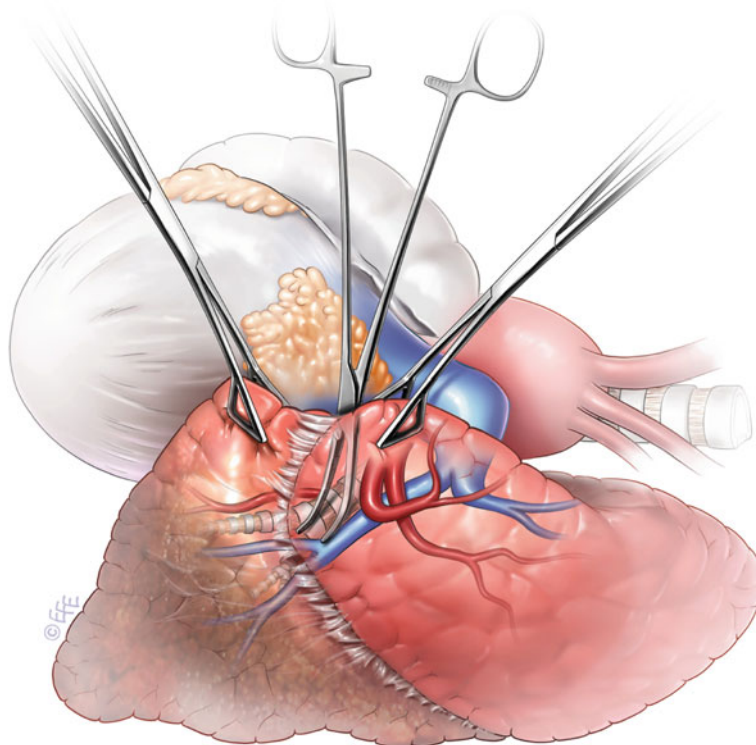
Because of chronic inflammation, large lymph nodes usually are encountered, as are dense adhesions of the affected pulmonary parenchyma and the healthy lungs, chest wall,

pericardium, great vessels, and diaphragm. Meticulous dissection of these adhesions and lymph nodes is the cornerstone of the operation.

**Figure 23.1**



**Figure 23.2**



**Figure 23.3**

Because large and firm lymph nodes generally are found in the fissure over the interlobar pulmonary artery, ligating the pulmonary vein first may cause distension of the lobe during the time-consuming arterial dissection. Therefore, vascular dissection preferentially starts from the arterial side. The main right or left pulmonary artery is encircled with tape to help control any bleeding that may occur during lymph node dissection over the artery in the fissure. Clearing the lymph nodes over the superior segmental artery helps the surgeon find the correct cleavage of the entire artery in the fissure. If a tunnel can be created between

the lymph node and the artery by opening the prevascular sheet, the lymph node can be resected and the artery ligated or stapled safely. In the presence of highly invasive lymph nodes, it is not possible to secure the artery safely. In these situations, the pulmonary vein is ligated first, then the bronchus is cut, and the remaining bundle containing the artery and lymph nodes is ligated or stapled. The bronchus is closed by hand suturing or a stapling device. (See also Chap. 17 for technical details on bronchial and vascular closures.)

**Figure 23.4**

The bronchiectatic middle lobe loses its structure completely and turns into a leaflike structure adhering to the interlobar surface of the upper lobe, which seems like a normal anatomic surface of the upper lobe. Separation is achieved best while the lung is inflated to find the space between the upper and middle lobes. Because the symphysis is not very strong, the two lobes can be separated by the tip of a finger or a plastic aspirator after opening the border between the lobes. Many firm lymph

nodes are seen on the interlobar pulmonary artery when the fissure is opened. In middle lobe syndrome, the middle lobe branch of the pulmonary artery generally is rudimentary, and at times it may be difficult to find a patent artery. Lymph nodes over the artery are dissected by opening a tunnel under the prevascular sheet. Middle lobectomy is completed as described in Chap. 17

Figure 23.3

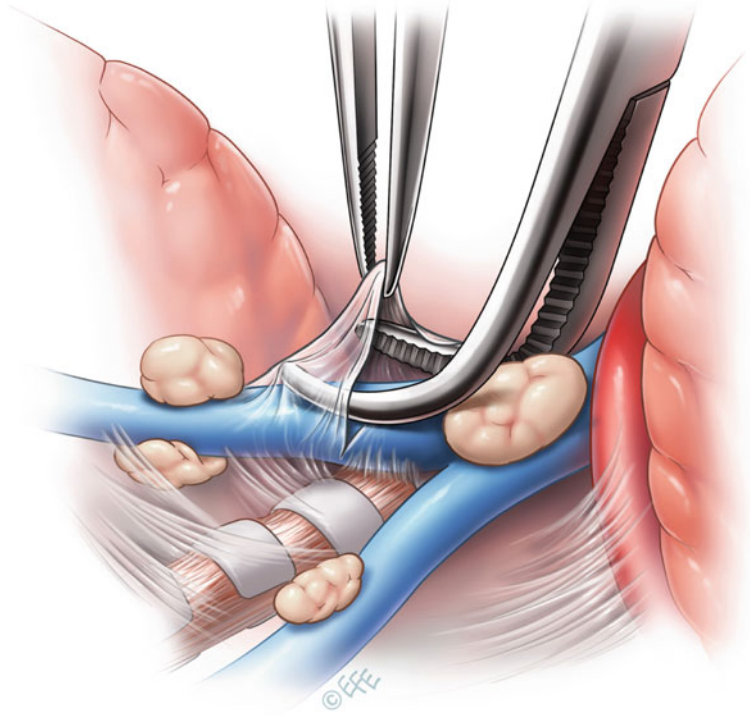
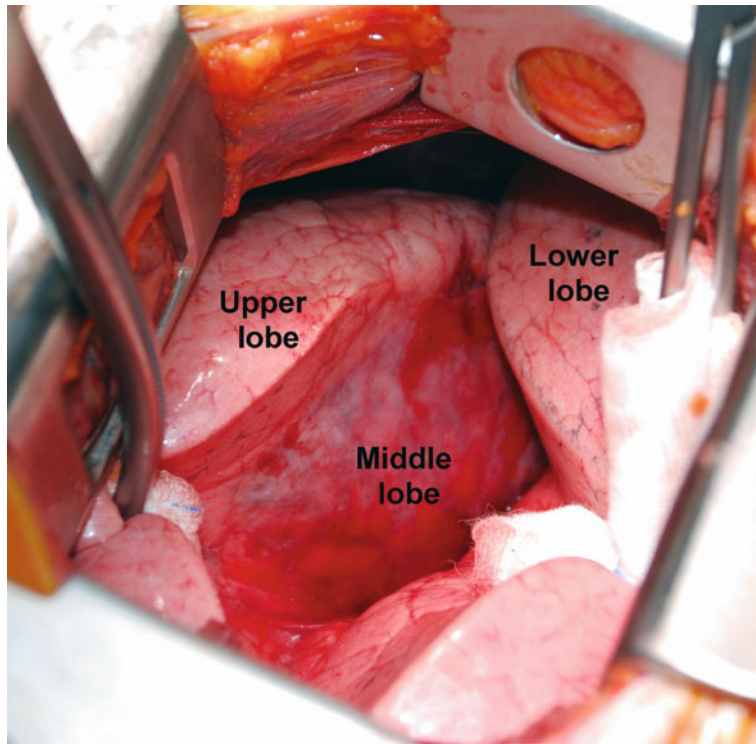


Figure 23.4





## Conclusion

Some patients with bronchiectasis can manage several infections per year or keep the disease under control by adhering to the recommended precautions; others may be very dissatisfied even with localized segmental bronchiectasis because of its clinical consequences, such as the frequent discharge of sputum or bad breath. Therefore, the timing of surgery for elective cases is closely related to the patient's demand.

It should not be presumed that the bronchiectatic area can be recognized intraoperatively at all times. A destroyed lobe is easily recognizable, but segmental bronchiectasis cannot always be differentiated during exploration. Hence, it is necessary to plan which segment will be removed after careful inspection of chest HRCT scans in the preoperative period. Even if the pulmonary parenchyma seems quite "healthy" during the operation, the segment that was observed to be bronchiectatic on HRCT should be removed to prevent symptom recurrence.

Aspiration of bronchial secretions with rigid bronchoscopy under general anesthesia before intubation is helpful in preventing spillage into other segments of the operated lung, which may cause postoperative atelectasis. Double-lumen intubation also remains crucial to controlling the flow of bronchial secretion from the diseased to the healthy lung. The anesthesiologist must be aware that there will be a large amount of bronchial secretion when the patient is in the lateral decubitus position, that this will increase during palpation of the lung, and that he or she must aspirate the endobronchial tube at frequent intervals throughout the operation (Doğan et al. 1989).

Although lobectomy by video-assisted thoracic surgery (VATS) also may be used, because of the dense adhesions and enlarged lymph nodes around the bronchovascular structures, rates of conversion to thoracotomy may be higher during the learning curve. Still, VATS lobectomy is not recommended unless the surgical team has considerable experience with open resection for inflammatory lung diseases. Bilateral bronchiectasis is not an absolute contraindication for surgery in which the complete resection of all diseases is possible. Nevertheless, meticulous preoperative investigations, including sophisticated cardiopulmonary

tests and detailed laboratory examinations, should be performed to select appropriate patients and exclude systemic or genetic-related diseases, such as ciliary activity disorders or defects in host defense, to prevent complications and recurrence after surgery.

The postoperative mortality rate of lung resection is similar to that of lung resection performed for other reasons; however, as in all inflammatory disease operations, morbidity is higher because of atelectasis and pneumonia caused by mucus plugging (Eren et al. 2007). Lung reexpansion problems also may be seen in patients with tuberculosis bronchiectasis or those who have undergone bilobectomy or lobectomy together with a segmentectomy. It is possible to reduce complications by decreasing bronchial secretion with antibiotic and postural drainage in the preoperative period, application of fibrin sealant when necessary, and creation of a pleural tent when possible. Yet, most complications can be managed conservatively, and surgical resection of localized disease remains rewarding, as patients have a more comfortable life, which was previously deranged with frequent bronchopulmonary infections, significant sputum production, and unpleasant breath odor.

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