then treated with 50 mg of prednisone orally for four weeks and reduced dosages afterwards, which led to a dramatic improvement of symptoms. Four months after the start of therapy, FVC, FEV₁, and PaO₂ were normal, but incomplete radiologic regression was observed at this time. The antibody titer decreased to less than 1:64 after seven weeks of steroid therapy and remained below that level.

**DISCUSSION**

Acute Legionella pneumonia is a severe bacterial infection with a high mortality rate.¹,² Fatal outcome after the acute phase subsides is not infrequent despite adequate erythromycin therapy.³ The most prominent pathologic finding in these instances was pulmonary fibrosis. Milder courses have shown persistent alveolitis with restrictive impairment of ventilation. We believe that our patients belong to the latter group.

Infection with *L pneumophila* was diagnosed on the basis of an indirect immunofluorescent test. In patient 1, the titer rose to 1:512, whereas in patient 2 the maximum of 1:512 was found initially. The decrease of the titers in the later stages confirmed the diagnosis. In one patient, infection was further substantiated by direct staining of bacteria with the Dieterle silver impregnation method.

The patients’ chest roentgenograms and pulmonary function tests were characteristic of alveolitis for a number of months. In addition, both patients had alveolitis with interstitial fibrosis on lung biopsy specimen. The therapy with corticosteroids resulted in a dramatic improvement of clinical symptoms and lung function parameters. However, residual infiltrates were still detectable on chest roentgenograms for many months. In patients such as ours with a highly suspected causal relationship between Legionella infection and fibrosing alveolitis, we recommend corticosteroid treatment, since fatalities from lung fibrosis have been reported when treatment has consisted of erythromycin alone.⁴,⁵

**REFERENCES**


**Primary Endobronchial Actinomycosis in Association with Foreign Body Aspiration**

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A 66-year-old diabetic man presented with a bilobar pneumonia two months after aspiration of a chicken bone. Flexible fiberoptic bronchoscopy demonstrated a mass in the bronchus intermedius. Histologic examination of endobronchial biopsy specimens revealed bone fragments, vegetative matter, and sulfur granules containing Actinomyces organisms. The patient responded to bronchoscopic removal of the foreign body and penicillin therapy. To our knowledge, the association of actinomycotic infection with an aspirated endobronchial foreign body has not previously been reported.

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Actinomycosis causes a chronic supplicative infection most commonly involving the cervicofacial region, thorax, and abdomen. The causative organisms, Actinomyces, are slow-growing, filamentous, Gram-positive bacteria that are endogenous oral saprophytes. They dwell in carious teeth, dental plaque, and gingival and tonsillar crypts. Thoracic infection results from aspiration of infected oral contents, and may involve the lungs, pleura, mediastinum, or chest wall.¹

The infection typically spreads without regard to anatomic barriers, but involvement of major bronchi is rare. Primary endobronchial actinomycosis is exceptionally uncommon. We report the previously undocumented association of primary endobronchial actinomycosis with an aspirated endobronchial foreign body.

**CASE REPORT**

In June 1990, a 66-year-old man with a four-year history of noninsulin-dependent diabetes mellitus suffered an episode of choking while eating chicken. He developed a nonproductive cough that resolved spontaneously after two weeks. A week later, he underwent extraction of two carious lower teeth. Two years earlier, all of the patient's upper teeth were removed because of diffuse disease. The following day, the cough returned. His physician prescribed oral antibiotics for pneumonia. The cough persisted, and one week later, he noted fever that subsided coincident with one intramuscular injection of penicillin. Despite two additional courses of oral antibiotics, the cough continued. After two months of persistent symptoms and roentgenographic abnormalities, the patient was seen at the Mount Sinai Medical Center, New York.

On further questioning, he denied any history of alcohol abuse, seizure disorder, or episodes of loss of consciousness. Physical examination revealed a chronically ill man appearing older than his

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66 years. He lacked all upper and several lower teeth. Of the teeth that remained, several were carious. Decreased breath sounds and crackles were heard at the posterior base of the right lung. Chest roentgenogram revealed dense consolidation of the right lower and middle lobes with inferior displacement of the right hilum consistent with postobstructive pneumonia (Fig 1). Computed tomography of the chest demonstrated adenopathy in the pretracheal, precardial, and right hilar regions, and confirmed consolidation with associated volume loss of the right lower and middle lobes. An endobronchial calcification was identified within the lumen of the bronchus intermedius (Fig 2).

The patient underwent flexible fiberoptic bronchoscopy. A large, pearly gray, slightly friable, polypoid mass was noted in the bronchus intermedius obstructing 90 percent of the lumen. Biopsy of the lesion provided two specimens consisting of soft, tan-brown tissue with a 1.5 x 1.0 x 0.8-mm fragment of irregularly shaped bone accompanying one of the samples. Histologically, both specimens revealed fragments of bone and foreign material resembling plant matter. These fragments were surrounded by an acute inflammatory exudate and sulfur granules. The organisms stained positively with Gomori methenamine silver, but were not acid-fast, consistent with Actinomyces species (Fig 3).

Rigid bronchoscopy was subsequently performed under general anesthesia using a 7.5-mm bronchoscope (Storz). Ventilation was provided by a jet ventilator at a rate of 150/min. Abnormal findings were confined to the bronchus intermedius. The lumen was 90 percent obstructed by a fragment of chicken bone and the granulation tissue that had grown around it. The bone was removed in two pieces with foreign body grasping forceps. After removal of the foreign body, all orifices were visualized; the middle lobe and posterior basal bronchi were narrowed.

The patient was treated initially with intravenous penicillin, 2 million units every 6 h for two weeks, followed by oral penicillin VK 250 mg with probenicid 250 mg every 6 h. His cough resolved, and he remained free of other symptoms. Serial chest roentgenograms documented gradual resolution of the right lung consolidation.

**DISCUSSION**

Primary endobronchial actinomycosis is exceedingly rare. A Medline search revealed only four cases of actinomycotic infection involving the major bronchi reported in the past 25 years. In two of the patients, endobronchial lesions resulted from extension of intrapulmonary disease. Evaluation of unresolved pneumonia in one patient led to the diagnosis of endobronchial lipoma with superimposed actinomycosis. Another patient, who had required transient endotracheal intubation six months earlier, presented with a large mass, containing microscopic foci of vegetable cells and a sulfur granule, occluding the right middle lobe bronchus, without parenchymal involvement.

To our knowledge, primary endobronchial actinomycosis associated with the aspiration of a macroscopic foreign body has not previously been described. This patient's history of poor oral hygiene and multiple dental procedures predisposed him to oropharyngeal infection. Endobronchial entry of Actinomyces organisms presumably occurred either simultaneously with the aspired foreign body or during the subsequent dental procedure.

The cause of the patient's bilobar pneumonia remains unclear. Certainly, aspirated Actinomyces organisms may have caused the bilobar infiltrate. On the other hand, the extent of actinomycotic infection may have been limited to the aspired foreign body. This mass in the bronchus intermedius could subsequently have caused a postobstruc-

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**FIGURE 1.** Chest roentgenogram demonstrates right lower lobe infiltrate with inferior displacement of the right hilum consistent with volume loss of the right lower lobe.

**FIGURE 2.** Computed tomography at the level of the bronchus intermedius reveals right lower lobe infiltrate and calcification within the lumen of the bronchus intermedius.

**FIGURE 3.** Gram stain revealing numerous filamentous Actinomyces species surrounding a tiny bone fragment (center) and aggregating in a sulfur granule (upper left) (original magnification × 100).
The Effect of Pressure Support Ventilation on Auto-PEEP In a Patient with Asthma*

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We report the effect of pressure support ventilation (PSV) on auto-PEEP in a patient with asthma. The patient showed a high level of auto-PEEP during spontaneous breathing through a T-piece. PSV effectively decreased auto-PEEP and inspiratory muscle effort with increasing levels of PSV.

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Auto-PEEP in patients with chronic obstructive pulmonary disease receiving mechanical ventilation is a well-described phenomenon.1,2 Auto-PEEP may potentiate barotrauma and deleterious hemodynamic consequences of dynamic hyperinflation. Therefore, the auto-PEEP level should be minimized by changing ventilatory mode or ventilator settings. To our knowledge, however, there have been no reports of auto-PEEP in patients with asthma who are breathing spontaneously during continuous positive airway pressure ventilation or pressure support ventilation (PSV). The effect of PSV on auto-PEEP is also unclear. We report the effect of PSV on auto-PEEP in a patient with asthma.

CASE REPORT

A 77-year-old woman with a history of asthma was admitted to our hospital for a lung tumor detected on chest roentgenogram. She had no history of chronic bronchitis or emphysema. Admission diagnosis was lung abscess. Preoperatively, the airways appeared to be normal by bronchoscopy. Partial resection of the right upper lobe of the lung was performed. After surgery she was not extubated because wheezing was noted. There was no postoperative hemorrhage in the airway. She was transferred to the intensive care unit (ICU) and ventilated with PSV (7200a, Puritan-Bennett, Los Angeles, CA) through a 7.0-Fr size endotracheal tube. PSV level was 10 cm H2O. Twenty minutes after transfer to the ICU, she showed marked respiratory effort with use of accessory muscles. An attack of asthma developed and she complained of dyspnea. Ventilation was continued at PSV 10 cm H2O without PEEP. Aminophylline, 250 mg, was given intravenously, and salbutamol was also given by inhalation. One hour after treatment the dyspnea disappeared, despite persistent severe wheezing. Arterial blood gas values were as follows: pH, 7.40; PaO2, 136 mm Hg; and PaCO2, 38 mm Hg on FiO2 0.4. The airway resistance, which was measured under controlled ventilation with the square-wave flow pattern with end-inspiratory pause, was 25 cm H2O/L/s. As the severe wheezing persisted, several ventilatory modes, ie, spontaneous breathing through a T-piece and PSV 0, 5, 10, and 15 cm H2O were employed in random order. Each mode was used for 10 min, and breathing pattern variables, including auto-PEEP, were measured at the end of use of each mode.

![Figure 1. Continuous recordings of flow, airway pressure, and esophageal pressure during pressure support ventilation at 0, 5, and 10 cm H2O in a patient with asthma. Auto-PEEP and fluctuation of esophageal pressure were minimal at pressure support ventilation 10 cm H2O.]

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