

CASE RECORDS of the MASSACHUSETTS GENERAL HOSPITAL

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Case 12-2006: A 37-Year-Old Man with Hemoptysis and a Pulmonary Infiltrate

Fiona K. Gibbons, M.D., John A. Branda, M.D., and Jo-Anne O. Shepard, M.D.

PRESENTATION OF CASE

Dr. Michael D. Howell (Pulmonary and Critical Care Unit): A 37-year-old man was seen in the pulmonary clinic of this hospital because of blood-streaked sputum and an abnormal result on computed tomography (CT) of the chest.

The patient, who was a physician, had been well until six weeks earlier, when he began to have drenching night sweats approximately twice a week without fever. He had no other symptoms, except for a decade-long morning cough, which he attributed to cigarette smoking. Six days before his presentation at the clinic, he noticed a small amount of blood in the sputum produced by his usual morning cough. He underwent chest radiography, which was reported to be normal. He produced blood-streaked sputum on two subsequent days. CT of his chest showed an opacity, 3.8 by 2.3 cm, in the posterior segment of the right lower lobe of his lung that abutted the pleura, contained air bronchograms, and was suggestive of cancer. A CT scan of the chest obtained three years earlier had been normal. He began taking levofloxacin orally. Three days later, he was seen in the pulmonary clinic of this hospital.

The patient's hemoptysis had not recurred. He did not have fever, chills, weight fluctuations, shortness of breath, swollen lymph nodes, pain of any kind, headaches, double vision, known exposure to tuberculosis, urinary problems, constipation, nausea, vomiting, rashes, joint problems, or edematous legs. He reported performing a monthly testicular self-examination and had not noticed any changes or any swollen lymph nodes. He did not have trouble swallowing and did not cough after eating or drinking.

He had a history of approximately 15 pack-years of smoking cigarettes and was under treatment for depression but had no other medical problems. His only usual medication was escitalopram; he had taken self-prescribed levofloxacin for three days before the clinic visit. He did not drink alcohol or use illicit drugs. He had emigrated from the Middle East many years earlier and was married, with two young children. He had been in practice as an internist in a suburb of Boston for approximately a decade; annual tuberculin skin tests had been negative, most recently six weeks before the onset of this illness. There was no family history of cancer.

On examination, the patient was afebrile and was not coughing. The pulse was 96 beats per minute and regular, the respiratory rate 16 breaths per minute

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and unlabored, and the oxygen saturation 97 percent while the patient was at rest breathing room air. The physical examination was normal.

The results of a complete blood count were normal, with no increase in eosinophils. The levels of urea nitrogen, creatinine, electrolytes, total bilirubin, total protein, albumin, aspartate aminotransferase, alanine aminotransferase, and alkaline phosphatase were normal, as were the results of a urinalysis. The level of glucose was 133 mg per deciliter (7.4 mmol per liter), and the erythrocyte sedimentation rate was 12 mm per hour.

Metronidazole was prescribed, and levofloxacin was continued. Five days after the clinic visit, a scheduled CT-guided needle biopsy of the lung lesion was canceled, because the lesion had decreased in size to 1.5 by 2.4 cm.

The patient completed a 14-day course of levofloxacin and metronidazole and stopped smoking. His morning cough resolved, but he continued to have night sweats, averaging twice a week. Another CT scan of the chest obtained three weeks after the canceled biopsy showed continuing diminution in the size of the opacity in the right lower lobe of the lung, which was believed to be consistent with resolving pneumonia; the scan was otherwise normal.

Three months later, another CT scan showed that the original lesion had resolved; however, two new nodules, each 7 mm in diameter, were present — one in the posterior basal segment of the right lower lobe and the other in the inferior right hilum adjacent to the segmental bronchus. There were patchy parenchymal opacities along the bronchovascular structures in the inferior hilar region, accompanied by mild peribronchial thickening. The findings were suggestive of recurrent bronchopneumonia, particularly aspiration pneumonitis.

The patient was contacted by telephone; he said that he had had no symptoms of aspiration or gastrointestinal reflux and had not consumed alcohol or taken other drugs. He had no cough, fevers, or chills. His night sweats were unchanged in frequency and character, but he felt well otherwise.

A diagnostic procedure was performed.

DIFFERENTIAL DIAGNOSIS

Dr. Fiona K. Gibbons: May we review the radiologic studies?

Dr. Jo-Anne O. Shepard: CT of the chest performed

three days before the patient's visit to the pulmonary clinic (Fig. 1A) showed a mass in the posterobasal segment of the right lower lobe of the lung abutting the mediastinal pleura. The mass contained an air bronchogram and had irregular margins; there was no sign of lymphadenopathy or pleural effusion. A repeated CT scan obtained three weeks after the canceled biopsy (Fig. 1B) demonstrated that the nodule in the right lower lobe had decreased further in size and was almost linear in configuration, consistent with a resolving inflammatory process. Three months later, another CT scan (Fig. 1C) revealed two new small pulmonary nodules in the right lower lobe; there was also new thickening along the peribronchial region in the right lower lobe associated with some peribronchial lymphadenopathy (Fig. 1D and 1E). The left lung remained clear; there was no pleural effusion and no mediastinal lymphadenopathy.

Dr. Gibbons: This patient presented with night sweats, hemoptysis, and a mass in the chest. Important clues to the diagnosis may be found in his history: he was from the Middle East, he was a physician, and he was a smoker. Although I am aware of this patient's diagnosis, this case provides an opportunity to review the evolution of a pulmonary disease during a specified number of months. It illustrates the importance of a carefully obtained history; thoughtful consideration of data as they emerge, with adjustment of the differential diagnosis accordingly; and following abnormal radiographs to resolution.

NIGHT SWEATS AND HEMOPTYSIS

Night sweats are defined as drenching sweats that occur only or mainly at night and cause the person to change bedclothes. Tuberculosis and lymphoma are the first diagnoses that come to mind, but in practice they are infrequent causes of night sweats.¹ Obstructive sleep apnea, anxiety disorder, pregnancy, gastroesophageal reflux disease, and angina have also been associated with night sweats,² as have the diseases and drugs outlined in Table 1. Causes of hemoptysis are outlined in Table 2.^{3,4} In a series from the United States,⁵ the most common causes were bronchitis (26 percent), lung cancer (23 percent), pneumonia (10 percent), and tuberculosis (8 percent). In other parts of the world, bronchiectasis is a common cause of hemoptysis.

The cause of this patient's night sweats and

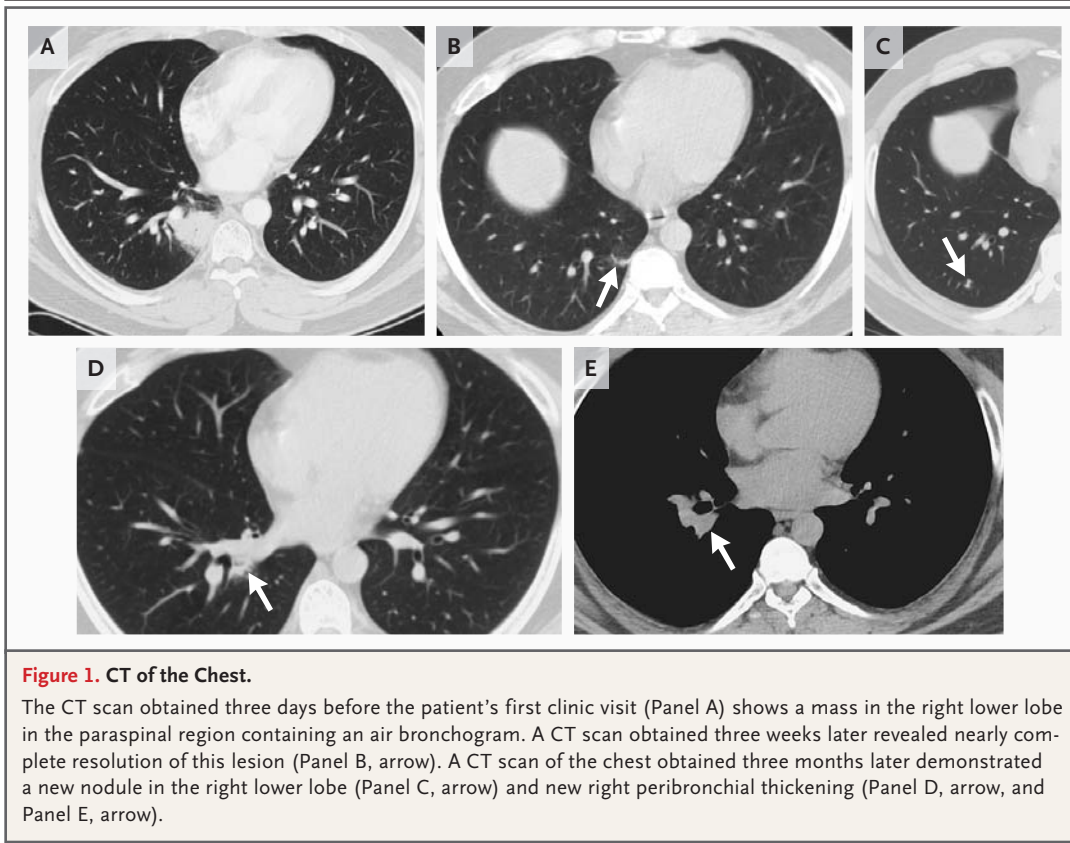


Figure 1. CT of the Chest.

The CT scan obtained three days before the patient's first clinic visit (Panel A) shows a mass in the right lower lobe in the paraspinous region containing an air bronchogram. A CT scan obtained three weeks later revealed nearly complete resolution of this lesion (Panel B, arrow). A CT scan of the chest obtained three months later demonstrated a new nodule in the right lower lobe (Panel C, arrow) and new right peribronchial thickening (Panel D, arrow, and Panel E, arrow).

hemoptysis can be narrowed to infection or cancer on the basis of his age, sex, history, and normal laboratory data and physical examination. Simple laboratory investigations should be performed to rule out diabetes, thyroid disease, and infection with the human immunodeficiency virus (HIV).

Tuberculosis

Although the patient's negative results on a tuberculin skin test 12 weeks before his presentation argue against a diagnosis of tuberculosis, anergy has been reported in as many as 25 percent of those with active pulmonary tuberculosis.⁶ This patient is at risk for tuberculosis because he emigrated from the Middle East, a region that accounted for 7 percent of all incident cases of tuberculosis globally as of 2002.⁷ Foreign-born persons account for just over half the cases of tuberculosis in the United States reported to the Centers for Disease Control and Prevention, a rate that is nine times that among those born in the United States.⁸ In Massachusetts, 80 percent of the cases reported in 2003 occurred in foreign-

born persons, most of whom had resided in the United States for one to four years.⁹

This patient is also a physician. As a health care worker, he is at increased risk for tuberculosis as compared with the general population, especially if he cares for a population of high-risk patients. Therefore, although this patient has resided in the United States for 10 years, we must consider tuberculosis as a possible cause of his night sweats and hemoptysis.

Cancer

Since this patient is younger than 40 years of age, infection is a more likely diagnosis than cancer. Fewer than 15 percent of patients with bronchogenic carcinoma are younger than 50 years of age, and more than 90 percent of those with the diagnosis use tobacco. In one study, the median cumulative cigarette consumption among smokers younger than 50 years of age with lung cancer was 30 pack-years (range, 3 to 100).¹⁰ According to the American Cancer Society, the estimated probability of cancer among males is 0.03 percent from birth to 39 years of age, 1.08 percent from

Table 1. Diseases and Drugs Associated with Night Sweats.

Infection	Endocrine causes
Bacterial infection	Menopause
Pneumonia	Diabetes mellitus
Endocarditis	Diabetes insipidus
Lung abscess	Hyperthyroidism
Viral infection	Orchiectomy
Epstein–Barr virus	Acromegaly
Human immunodeficiency virus	Rheumatologic causes
Cytomegalovirus	Takayasu's arteritis
Mycobacterial infection	Temporal arteritis
<i>Mycobacterium tuberculosis</i>	Drugs
<i>M. avium</i> complex	Salicylates
Fungal infection	Acetaminophen
Histoplasmosis	Meperidine
Coccidioidomycosis	Antipsychotic agents
Other	Antihypertensive agents
Malignant causes	Insulin
Lymphoma	Niacin
Hodgkin's lymphoma	Tamoxifen
Non-Hodgkin's lymphomas	Alcohol
Leukemia	Heroin
Endocrine tumors	
Pheochromocytoma	
Carcinoid	

40 to 59 years, and 5.75 percent from 60 to 79 years.¹¹ Therefore, although I cannot discount a diagnosis of bronchogenic cancer in this 37-year-old man with a 15-pack-year smoking history, the probability is low.

The probability of lymphoma in a 37-year-old man with night sweats is higher than that of carcinoma. According to the American Cancer Society, the probability of non-Hodgkin's lymphoma in a male from birth to 39 years of age is 0.14 percent, almost five times the probability of lung cancer.¹¹ Hodgkin's lymphoma has a bimodal age-specific incidence, with peaks between 15 and 34 years of age and again at more than 60 years of age in most European, North American, and Australian populations; this patient is only slightly past the older end of the first peak.¹² Up to a third of adults with Hodgkin's lymphoma have constitutional symptoms, including fevers and drenching night sweats.¹³ Although rare, there are reports of patients with endobronchial Hodgkin's

lymphoma presenting with cough and hemoptysis.¹⁴

DIFFERENTIAL DIAGNOSIS ACCORDING TO INITIAL CT FINDINGS

This patient had a mass-like pulmonary opacity in the posterior segment of the right lower lobe of his lung, with areas of ground-glass opacity and dense consolidation with air bronchograms. The location in the posterior basal segment of the right lower lobe raises the possibility of an aspiration pneumonia; the right lower lobe is a common site because of the relatively vertical orientation of the right main bronchus. Ground-glass opacities are often due to inflammation, but they can also be seen with bronchoalveolar-cell carcinoma, adenocarcinomas, atypical adenomatous hyperplasia, lymphomas, and hemorrhage.¹⁵ The rounded, dense area of consolidation with air bronchograms could be consistent with the presence of bacterial, mycobacterial, or fungal pneumonia.

Table 2. Causes of Hemoptysis.

<p>Infections</p> <p>Bronchitis, chronic bronchitis</p> <p>Necrotizing pneumonia</p> <p> Staphylococcus species</p> <p> Influenza</p> <p> Klebsiella species</p> <p>Lung abscess</p> <p>Mycetoma</p> <p> Aspergillus</p> <p>Tuberculosis, nontuberculous mycobacteria</p> <p>Amebiasis</p> <p>Bronchiectasis</p> <p> Cystic fibrosis</p> <p>Broncholithiasis</p> <p>Arteriovenous malformations</p> <p>Cardiovascular causes</p> <p>Left ventricular failure</p> <p>Mitral stenosis</p> <p>Aortic aneurysm</p> <p>Bronchovascular fistula</p> <p>Pulmonary embolism or infarction</p> <p>Vasculitis</p> <p>Wegener's granulomatosis</p> <p>Goodpasture's syndrome</p> <p>Systemic lupus erythematosus</p>	<p>Neoplasms</p> <p>Bronchogenic carcinoma</p> <p>Bronchial adenoma</p> <p>Endobronchial carcinoid</p> <p>Endobronchial metastasis</p> <p>Trauma</p> <p>Pulmonary contusion</p> <p>Transthoracic needle biopsy</p> <p>Transbronchial biopsy</p> <p>Drugs</p> <p>Glycoprotein IIb and IIIa inhibitors</p> <p>"Crack" cocaine</p> <p>Trimetallic anhydride</p> <p>Penicillamine</p> <p>Nitrofurantoin</p> <p>Isocyanates</p> <p>Miscellaneous causes</p> <p>Pulmonary-capillary hemangiomatosis</p> <p>Idiopathic pulmonary hemosiderosis</p> <p>Aspirated foreign body</p> <p>Bronchocentric granulomatosis</p>
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Bronchoalveolar-cell carcinoma, bronchogenic carcinoma, and lymphoma can also appear as mass-like consolidations with air bronchograms. In a retrospective review of 31 patients with pulmonary lymphoma, the most common CT finding was a mass or mass-like consolidation; most of the patients had more than one abnormal finding on CT.¹⁶ Pulmonary pseudolymphomas can also appear as alveolar opacities on CT.¹⁷

Primary infection with tuberculosis typically occurs with lymphadenopathy (particularly in the right-sided paratracheal and hilar regions), pulmonary parenchymal disease, pleural effusion, or miliary disease.¹⁸ The areas of the lung that are commonly affected are the middle lobe, the lower lobes, and the anterior segments of the upper lobes, although any lobe may be affected.¹⁸ Consolidation usually occurs in a segmental or lobar distribution. There appears to be a right-sided predominance.¹⁹ In 5 to 10 percent of patients with

primary tuberculosis (most commonly in children less than one year of age, in teenagers, and in patients with T-cell immunodeficiencies), cell-mediated immunity is inadequate to contain the primary infection and progressive primary tuberculosis occurs.^{20,21} In these cases, the tuberculin test with purified protein derivative (PPD) may remain negative.²² The radiographic features are similar to those of postprimary tuberculosis.

Postprimary tuberculosis results from the reactivation of a latent primary infection. This form of the disease, which is sometimes referred to as reactivation tuberculosis, typically involves the apical or posterior segments of the upper lobes of the lung or the superior segments of the lower lobes, with patchy consolidation, often with cavitation. Endobronchial spread (identified on CT on the basis of poorly defined centrilobular nodules with branching — the so-called tree-in-bud appearance), nodules, bronchial-wall thickening,

or lobular consolidation may occur. Involvement of the tracheobronchial tree can result in bronchial stenosis with concentric-wall thickening, bronchial obstruction with surrounding peribronchial soft tissue or lymphadenopathy, and broncholithiasis.²¹ This patient has disease confined to the lower lung lobes, which is not typical of reactivation tuberculosis.

Approximately one third of patients with active pulmonary tuberculosis present with atypical findings.²³ Such findings may include lower-zone infiltration, which is reported in 1 to 7 percent of patients,²⁴ and may result from transbronchial perforation of a hilar lymph node, with spread to the adjacent lung. Lower-zone infiltration may explain the high incidence of endobronchial involvement in these cases.²⁵ Tuberculosis in the lower lung field appears to occur more frequently in patients who are younger than 40 years of age, such as this patient.^{24,26} A variety of chronic diseases, such as diabetes and renal and hepatic disease, have been reported more frequently in patients with lower-lung disease than in those without lower-lung involvement.^{24,27} The radiographic findings in these patients can resemble bacterial or viral pneumonia, and it may be difficult to identify tuberculosis on smear or culture.^{24,27} The findings in this patient, although atypical, thus fall within the spectrum of presentations of pulmonary tuberculosis.

At the time of this patient's presentation, on the basis of his age and history, the initial CT findings, the probability of cancer, and his smoking status, the most probable cause of the infiltrate in the right lower lobe was an infection, which could have been tuberculosis. The next most likely diagnosis was lymphoma, and the third possibility was bronchogenic cancer. Because of the concern about the possibility of cancer, his physician ordered a CT-guided transthoracic needle-aspiration biopsy. However, on subsequent CT scans, the infiltrate resolved, which made cancer an unlikely diagnosis.

DIFFERENTIAL DIAGNOSIS ACCORDING TO SUBSEQUENT CT FINDINGS

The marked improvement in the lung opacity after the institution of levofloxacin and metronidazole therapy suggests that this infiltrate was probably of infectious cause, due to an infection caused by a community-acquired or atypical organism or an aspiration pneumonia. However, despite

the near resolution of the infiltrate on the CT scan of the lungs and improvement of his cough, the patient continued to have night sweats, and a CT scan obtained three months later showed new abnormalities in the right lower lobe.

A two-week course of levofloxacin and metronidazole is sufficient to resolve most community-acquired or atypical infections. However, fluoroquinolones including levofloxacin, ciprofloxacin, gatifloxacin, and moxifloxacin also have bactericidal activity against *Mycobacterium tuberculosis*. Metronidazole is bactericidal to tubercle bacilli under anaerobic conditions. Both drugs may have beneficial adjuvant roles in the treatment of tuberculosis. Quinolones target bacterial type II DNA topoisomerases (DNA gyrase). Mutations in these enzymes result in resistance, which can be acquired rapidly, particularly in the setting of monotherapy with a fluoroquinolone.^{28,29} If a diagnosis of tuberculosis is suspected, attempts should be made to confirm it before the initiation of empirical quinolone therapy for pneumonia, since the drug could both delay the diagnosis and promote resistance.^{30,31}

Although recurrent aspiration was suggested by the location of the infiltrate on the CT scans of the chest, this diagnosis is unlikely in a young patient without symptoms of reflux or cough. The combination of night sweats, hemoptysis, and a mass-like infiltrate in the lower lobe of the right lung that initially regressed with antibiotic therapy and then rapidly recurred in the same region of the lung is consistent with an atypical presentation of primary tuberculosis and suggests the diagnosis of progressive primary tuberculosis. The resolution of the original infiltrate could be attributed either to a partially successful cell-mediated immune response to the original infection or to incomplete treatment of tuberculosis with levofloxacin.

The next step in establishing a diagnosis in this case should include induction of sputum for smears and culture for mycobacteria.

The CT findings in this case should be followed to resolution. Bronchogenic carcinoma and tuberculosis often coexist, either coincidentally or owing to the formation of scars in which cancers may arise. In addition, carcinoma may lead to reactivation of tuberculosis by eroding into an encapsulated focus or by decreasing the patient's immunity.³²

Dr. Charles A. Hales (Pulmonary and Critical Care

Unit): Sarcoidosis is another cause of night sweats. However, it is usually accompanied by fevers, and hemoptysis is uncommon.

A Physician: Does it concern you that the infiltrate resolved but the night sweats persisted?

Dr. Gibbons: Yes. I think that is the key finding in this case. If the physicians taking care of this patient had not paid close attention to the fact that he had continued night sweats, we might have easily missed the diagnosis, since the initial infiltrate resolved with conventional therapy.

Dr. Nancy Lee Harris (Pathology): Dr. Howell, what was your thinking, and what happened next?

Dr. Howell: When I first saw this patient, he had no symptoms of pneumonia; I was concerned about the possibility of bronchioloalveolar carcinoma or another cancer and about aspiration pneumonia because of the location of the infiltrate. When subsequent CT scans showed resolution of the infiltrate, the diagnosis of cancer was less probable, but I was bothered by the persistent night sweats. The final CT scan raised concern about aspiration pneumonia, so I called the patient and tried to elicit information that might suggest an aspiration syndrome. When this failed, I asked him to repeat his PPD test. Two days later, it was positive, with induration of 20 mm. I saw him the next day, and the PPD result was then 38 mm. We obtained induced-sputum samples for smears and culture and started four-drug therapy.

CLINICAL DIAGNOSIS

Progressive primary tuberculosis.

DR. FIONA K. GIBBONS'S DIAGNOSIS

Progressive primary tuberculosis.

PATHOLOGICAL DISCUSSION

Dr. John A. Branda: The smear of the patient's first induced-sputum specimen was negative for acid-fast organisms. The specimen was cultured in a liquid Middlebrook medium (BACTEC 12B with antimicrobial supplementation) as well as on a solid egg-based (Lowenstein-Jensen) medium. The culture on solid medium remained negative throughout its eight-week incubation, but the broth culture became positive on day 14. On day 18, a Ziehl-Neelsen smear from the broth revealed acid-

fast rods with cord formation (Fig. 2A). Because these morphologic features suggest the diagnosis of *M. tuberculosis*,³³ a nucleic acid hybridization test (Accuprobe, Gen-Probe) was performed, confirming the identification of an organism of the *M. tuberculosis* complex. A subculture of the broth, grown on Middlebrook 7H11 agar, revealed colonies of a single type, with morphologic characteristics of *M. tuberculosis* (Fig. 2B).³³ Rapid breakpoint-susceptibility testing³⁴ revealed susceptibility to streptomycin, isoniazid, rifampin, ethambutol, and pyrazinamide.

The isolate was referred to the Massachusetts State Laboratory Institute, where the identification was confirmed and susceptibility testing was repeated according to the standard method (agar proportion),³⁴ confirming susceptibility to streptomycin, isoniazid, rifampin, and ethambutol, as well as to kanamycin, cycloserine, capreomycin, ethionamide, and ciprofloxacin. A second in-

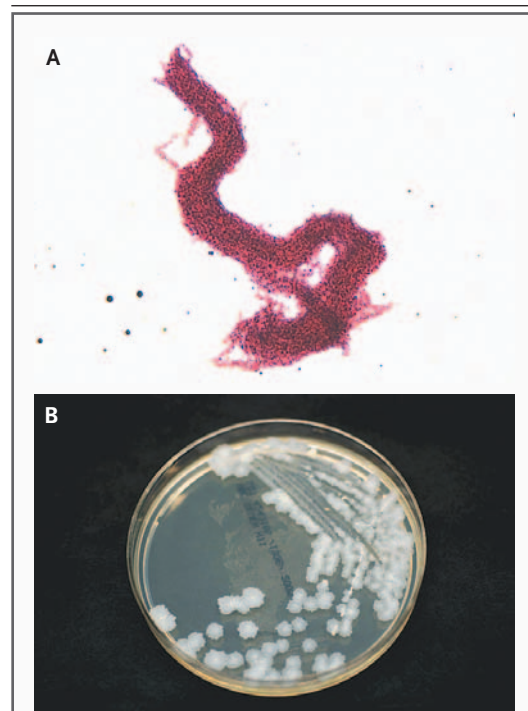


Figure 2. Microbiologic Diagnosis of Tuberculosis.

The smear of the primary broth culture for mycobacteria (Panel A) shows acid-fast rods aggregating in the distinct cord formation that is characteristic of *Mycobacterium tuberculosis* (Ziehl-Neelsen stain). Colonies of the *M. tuberculosis* complex isolate that were subcultured on Middlebrook 7H11 agar (Panel B) are flat, dry, rough, and nonpigmented, typical of *M. tuberculosis*.

duced-sputum specimen tested three days later was also negative for acid-fast organisms but culture-positive for *M. tuberculosis* complex.

Dr. Howell: Four-drug therapy was begun, even though the smears were negative, because the clinical syndrome strongly suggested primary progressive tuberculosis. After a week, the patient's night sweats markedly improved, and by two weeks they had disappeared. After two months, the smear and culture were both negative, so we converted to two-drug therapy with isoniazid and rifampin. A test for HIV was negative. Although I planned six months of therapy, the patient wished to continue it for nine months, which we did. At follow-up examination six months after completion of the therapy, he was well and his chest CT scan was normal. He is no longer being followed up at our clinic.

Dr. Harris: Did you find out how this patient was exposed to tuberculosis?

Dr. Howell: We involved the board of health to trace his contacts. His entire patient panel was reviewed, and no one seemed, even in retrospect, to have active tuberculosis. His office staff and other people with whom he had had contact, in-

cluding his family members and his two young children, underwent prospective tuberculin skin testing; all of these tests were negative. Tuberculosis did not subsequently develop in any of his office staff, family members, or me.

A Physician: Why did you not perform a bronchoscopy at the initial visit?

Dr. Howell: I discussed three options with the patient: observation and repeated CT in six weeks, bronchoscopy, and because of the location of the lesion, transthoracic needle biopsy. He opted for the needle biopsy.

Dr. Shepard: In lesions such as that seen on this patient's initial CT scan (a focal mass greater than 3 cm located in the periphery of the lung), percutaneous needle biopsy has a very high diagnostic yield, both for neoplasms and for focal infections, including tuberculosis and atypical tuberculosis.

ANATOMICAL DIAGNOSIS

Tuberculosis, primary, pulmonary.

Dr. Gibbons reports having received lecture fees from Pfizer. No other potential conflict of interest relevant to this article was reported.

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