

'Tree in Bud': case report

CASE REPORT

KW Liu¹ MB, BS, MRCP, DLK Dai² FRCP, DSC Hui² MD

¹ Medical and Geriatric Department, Shatin Hospital, Hong Kong

² Medical and therapeutic Department, Prince of Wales Hospital, Hong Kong

Correspondence to: Dr KW Liu, Shatin Hospital, Hong Kong. E-mail: kwliuhk@yahoo.com

INTRODUCTION

The 'tree-in-bud' appearance seen on computed tomographic scans of the thorax suggests a range of diagnoses. It can sometimes help diagnose and guide the management of illnesses in geriatric patients with multiple co-morbidities.

CASE REPORT

A 77-year-old woman with a medical history of primary Sjogren's syndrome and diabetes mellitus was admitted in April 2007 for limb weakness, which was diagnosed as a cerebrovascular accident. She developed an intermittent fever and her chest radiographs showed bilateral diffuse mottling. A full blood test gave a white blood cell count of $7.8 \times 10^9/L$ with a lymphocyte count of $0.9 \times 10^9/L$ and an erythrocyte sedimentation rate of 80 mm/h. Her

C-reactive protein was 40.5 mg/L. The patient had a non-productive cough initially. Although the lung infiltrations grew in size and extent, bronchoscopy was not performed because of her presumed recent cerebrovascular accident. In view of the persistent fever and increase in sputum production and lung infiltrations on chest radiographs, she was treated with a third-generation cephalosporin as having hospital-acquired pneumonia, followed by vancomycin when the sputum culture grew methicillin-resistant *Staphylococcus aureus*. The results of testing for acid-fast bacilli and sputum cytology were not available at that time. Her fever and abnormal chest radiological appearance persisted despite switching to vancomycin intravenously. A high-resolution computed tomography (HRCT) of her thorax showed multiple centrilobular nodules with a 'tree-in-bud' appearance (**FIG**). She was then treated empirically with the anti-tuberculosis



FIGURE. The "tree-in-bud" appearance seen on a high-resolution computed tomographic scan of the thorax

TABLE
Causes of the 'tree-in-bud' pattern*

Causes of the 'tree-in-bud' pattern	
Infection	Bacterial
	Tuberculosis
	Non-tuberculosis mycobacterial infection
	Fungal
	Aspergillus
Viral	Cytomegalovirus
	Respiratory syncytial virus
Idiopathic disorders	Obliterative bronchiolitis
	Diffuse panbronchiolitis
Congenital disorders	Cystic fibrosis
	Kartagener syndrome
Immunological disorders	Allergic bronchopulmonary aspergillosis
Connective tissue disorder	Rheumatoid arthritis Sjogren's syndrome
Miscellaneous	Aspiration
	Inhalation of toxic fumes of gases
	Langerhans cell histiocytosis
	Sarcoidosis
	Tumours Thrombotic micro-angiopathy

* Modified from Rossi SE, Franquet T, Volpacchio M, Gimenez A, Aguilar G. Tree-in-bud pattern at thin-section CT of the lungs: radiologic-pathologic overview. *Radiographics* 2005;25:789-801

drugs including ethambutol, isoniazid, rifampicin and pyrazinamide. The fever subsided slowly. Her body weight and appetite increased after several weeks of treatment. The inflammatory marker, C-reactive protein, decreased from 40.5 to 22.2 mg/L. Chest radiographs also improved. After 8 weeks, the sputum culture yielded *Mycobacterium tuberculosis* complex.

DISCUSSION

The differential diagnoses included (1) pulmonary tuberculosis, (2) lymphocytic interstitial pneumonia, (3) lymphoproliferative disorder with multiple pulmonary metastases. All these differential diagnoses were likely in this setting. A bronchoscopic examination, which was not performed in this case, might have provided the information needed to make a definitive diagnosis. The "tree-in-bud" appearance in the HRCT of the thorax offered another piece of valuable information.

The "tree-in-bud" pattern seen on CT was first described by Im et al¹ for the endobronchial spread of *M. tuberculosis*. Although it is often inappropriately considered a pathognomonic finding for tuberculosis, it actually indicates bronchiolar disease including

bronchiolar wall thickening, bronchiolar dilatation, and luminal impaction.²

The impaction is composed of secretions or fibrotic material manifesting as 2 to 4 mm nodular and linear branching centrilobular opacities on CT. The differential diagnoses include infections, immunological disorders, congenital disorders, neoplasms, aspiration of irritant substances and idiopathic causes (TABLE).

Webb et al³ studied nodular opacities seen on HRCT in patients with primary Sjogren's syndrome and other conditions including lymphoproliferative disorders and airway diseases. In a retrospective study of 60 patients with Sjogren's syndrome, Koyama et al⁴ identified seven with poorly defined centrilobular nodules and found it difficult to differentiate between airway diseases and lymphoproliferative disorders in these patients.

Diagnosing pulmonary tuberculosis can be difficult as it usually depends on the detection of acid-fast bacilli in cultures of sputum or bronchoalveolar lavage. Acid-fast bacilli are found in a limited number of patients (20-55%) with active pulmonary disease⁵ and chest radiographs are often

classified as indeterminate. It takes several weeks for cultures to yield results, so the microbiological diagnosis and appropriate treatment may be delayed. When tuberculosis is suspected clinically, computed tomography can help by revealing findings suggestive of tuberculosis when the radiographic findings do not clearly support it.⁶

Im et al¹ evaluated the HRCT findings in 41 patients newly diagnosed with active pulmonary tuberculosis. They found centrilobular lesions appearing as nodules or as branching linear structures (95%), bronchial wall thickening (73%), tree-in-bud appearance (71%), poorly defined nodules (61%), cavities (51%), and lobular consolidation (41%).

The endobronchial spread of *M. tuberculosis* represents a chronic granulomatous infection in which active organisms spread via the airways after caseous necrosis of a bronchial wall. The earliest appearance is a 'tree-in-bud' pattern of 2 to 4 mm centrilobular nodules and branching linear structures of similar calibre originating from a single stalk, if the infection is extensive enough.

CONCLUSION

Chest radiography remains the first option for evaluating patients with pulmonary tuberculosis. In recent years, HRCT has been found superior to chest radiography and standard CT in the assessment of parenchymal disease.⁷ Micro-nodules and the 'tree-in-bud' appearance are the most common HRCT

features in patients with newly acquired pulmonary tuberculosis, features not seen on the usual chest radiographs. This helps with decision making for early initiation of treatment for geriatric patients in Hong Kong. Tuberculosis is endemic in Hong Kong; 31.9% of tuberculosis patients were over 60 years of age in 1989; and this proportion increased to 45.4% in 1998.⁸ Older patients usually have more advanced disease at the time of diagnosis and significantly higher co-morbidity and mortality. Geriatricians should always consider the possibility of tuberculosis as a diagnosis.

References

1. Im JG, Itoh H, Shim YS, Lee JH, Ahn J, Han MC, et al. Pulmonary tuberculosis: CT findings—early active disease and sequential change with the antituberculous therapy. *Radiology* 1993;186:653-60.
2. Collins J, Blankenbaker D, Stern EJ. CT patterns of bronchiolar disease: what is "tree-in-bud"? *AJR Am J Roentgenol* 1998;171:365-70.
3. Webb WR, Muller NL, Naidich DP. HRCT findings of lung disease. In: Webb WR, Muller NL, Naidich DP, editors. *High-resolution CT of the lung*. 2nd ed. Philadelphia: Lippincott-Raven; 1996: 41-108.
4. Koyama M, Johkoh T, Honda O, Mihara N, Kozuka T, Tomiyama N, et al. Pulmonary involvement in primary Sjögren's syndrome: spectrum of pulmonary abnormalities and computed tomography findings in 60 patients. *J Thorac Imaging* 2001;16:290-6.
5. Hong YP, Kwon DW, Kim SJ. Tuberculosis in Korea: In: Hong YP, editor. *Management of tuberculosis*. Seoul: Ministry of Health and Social Affairs, Korean Academy of Tuberculosis; 1990: 3-4.
6. Lee KS, Im JG. CT in adults with tuberculosis of the chest: characteristic findings and role in management. *AJR Am J Roentgenol* 1995;164:1361-7.
7. Hatipoglu ON, Osma E, Manisali M, Ucan ES, Balci P, Akkoçlu A, et al. High resolution computed tomographic findings in pulmonary tuberculosis. *Thorax* 1996;51:397-402.
8. Chan-Yeung M, Noertjojo K, Tan J, Chan SL, Tam CM. Tuberculosis in the elderly in Hong Kong. *Int J Tuberc Lung Dis* 2002;6:771-9.