

Computed tomography and bronchoscopy in endobronchial tuberculosis

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H Yanardağ, C Tetikkurt, S Tetikkurt, S Demirci, T Karayel. Computed tomography and bronchoscopy in endobronchial tuberculosis. *Can Respir J* 2003;10(8):445-448.

BACKGROUND: The therapeutic response to endobronchial tuberculosis is usually evaluated by bronchoscopy. Currently, there are no published studies investigating the use of computed tomography for the evaluation of therapeutic response in endobronchial tuberculosis.

OBJECTIVE: A retrospective study was performed to evaluate the bronchoscopic and computed tomographic features of endobronchial tuberculosis before and after treatment. The aim of this study was to investigate the usefulness of computed tomography for the assessment of treatment.

METHODS: The clinical, pathological and bronchoscopic features of endobronchial tuberculosis were evaluated in 55 patients. The age range of the patients was 21 to 52 years. Computed tomography and bronchoscopy were performed before and after treatment.

RESULTS: Diagnosis of tuberculosis was confirmed by culture and histopathological examination. Bronchoscopic examination revealed 89 endobronchial lesions of various types in 55 patients. The exudative type was the most common. Follow-up bronchoscopy revealed that exudative-, ulcerative- and granular-type lesions healed completely. Computed tomography performed after treatment correlated well with the follow-up bronchoscopic findings.

CONCLUSION: The results suggest that follow-up computed tomography is useful for the evaluation of therapeutic response and complications associated with endobronchial tuberculosis, and may replace bronchoscopy.

Key Words: *Bronchoscopy; Computed tomography; Endobronchial tuberculosis*

Endobronchial tuberculosis is a serious complication of pulmonary tuberculosis. The exact pathogenesis is not completely understood (1,2). Because different mechanisms may play a role in the development of endobronchial disease, symptoms are frequently nonspecific, with various clinical and bronchoscopic findings. It may cause a diagnostic problem because of overlapping clinical and radiological features with other lung diseases (3).

Patients with endobronchial tuberculosis discharge large numbers of tubercle bacilli (4). Endobronchial involvement may also present as a therapeutic problem due to sequelae of cicatricial bronchostenosis (5). Hence, early diagnosis and treatment is essential to prevent both spread of tuberculosis and various complications associated with endobronchial tuberculosis.

There are sparse data on the clinical and bronchoscopic features of endobronchial tuberculosis apart from case reports and

La tomodensitométrie et la bronchoscopie en cas de tuberculose endobronchique

HISTORIQUE : D'ordinaire, la réponse thérapeutique à la tuberculose endobronchique est évaluée par bronchoscopie. Il n'existe aucune étude publiée sur l'usage de la tomodensitométrie pour évaluer la réponse thérapeutique de la tuberculose endobronchique.

OBJECTIF : Une étude rétrospective a été exécutée pour évaluer les caractéristiques bronchoscopiques et tomodensitométriques de la tuberculose endobronchique avant et après le traitement. La présente étude vise à explorer l'utilité de la tomodensitométrie pour évaluer le traitement.

MÉTHODOLOGIE : Les caractéristiques cliniques, pathologiques et bronchoscopiques de la tuberculose endobronchique ont été évaluées chez 55 patients de 21 à 52 ans. Une tomodensitométrie et une bronchoscopie ont été effectuées avant et après le traitement.

RÉSULTATS : Le diagnostic de tuberculose a été confirmé par un examen des cultures et un examen histopathologique. L'examen bronchoscopique a révélé 89 lésions endobronchiques de types variés chez les 55 patients. Le type exsudatif était le plus courant. Une bronchoscopie de suivi révélait la guérison complète des lésions de type exsudatif, ulcératif et granulaire. La tomodensitométrie exécutée après le traitement corrélait les observations bronchoscopiques de suivi.

CONCLUSION : Les résultats laissent supposer que la tomodensitométrie de suivi est utile pour évaluer la réponse thérapeutique et les complications associées à la tuberculose endobronchique et qu'elle pourrait remplacer la bronchoscopie.

several studies (1-3,6,7). The aim of the present study was to assess the usefulness of computed tomography (CT) for the evaluation of therapeutic response in endobronchial tuberculosis.

PATIENTS AND METHODS

During the five-year period from January 1997 to December 2002, a total of 55 patients with endobronchial tuberculosis were studied. Patients with lung cancer, chronic obstructive pulmonary disease and connective tissue disease were not included in the study. There were four cases of diabetes mellitus and one case of gastrectomy that may have influenced the onset of tuberculosis. All of the patients underwent fiberoptic bronchoscopy for the investigation of hemoptysis, persistent cough, unresolving pneumonia, abnormal radiological findings and smear-negative tuberculosis. The diagnostic criteria for endobronchial tuberculosis were certain endobronchial lesions, bronchoscopic biopsy compatible with

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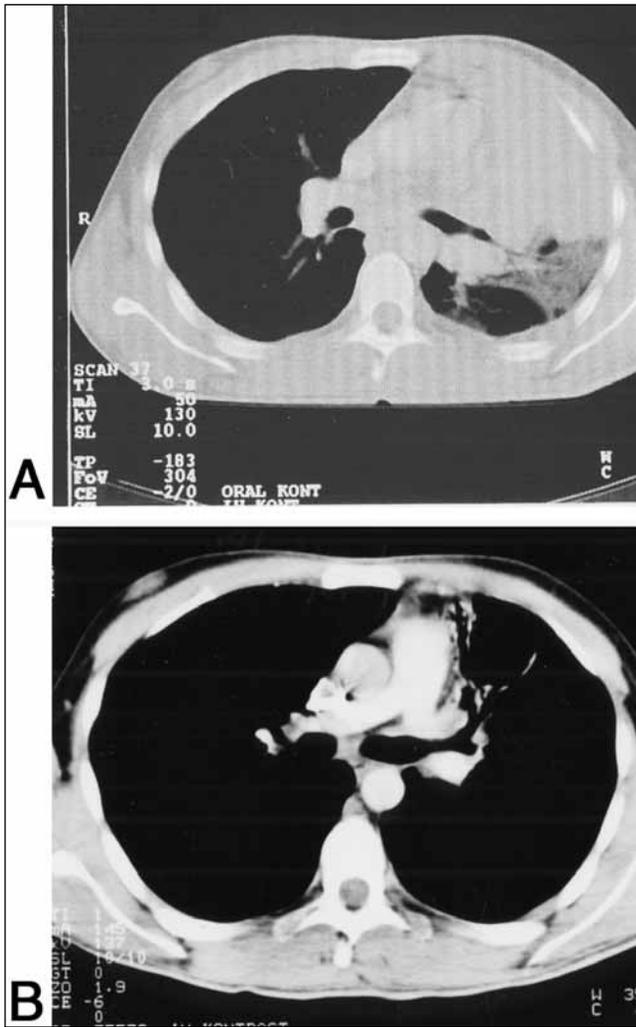


Figure 1 **A** Before treatment – computed tomography scan revealing left upper lobe atelectasis; **B** After treatment – computed tomography scan showing resolution of atelectasis with minimal residual fibrosis

tuberculosis and positive culture for tuberculosis. All of the patients underwent bacteriological studies of sputum, bronchial lavage and postbronchoscopic sputum with histopathological examination of the bronchial biopsy specimens.

The patients received isoniazid, rifampicin, pyrazinamide and ethambutol or streptomycin for the first two months of treatment, followed by isoniazid, rifampicin and ethambutol for the next six months, completing a total treatment period of eight months. None of the patients received steroids. Symptom assessment, plain chest radiographs, CT and bronchoscopy were performed for each patient after treatment.

RESULTS

The patients ranged in age from 21 to 52 years old; the peak incidence occurred in the third decade of life. The male to female ratio was 0.83. Symptoms at the onset were cough (71%), malaise (51%), fever (43%), sputum (21%), anorexia (20%), hemoptysis (18%) and chest discomfort (13%). Chest x-ray revealed patchy alveolar infiltration in 24 patients, atelectasis in 14 patients, cavitory lesions in seven patients, pleural effusions in five patients with two hydropneumothoraces, hilar enlargement

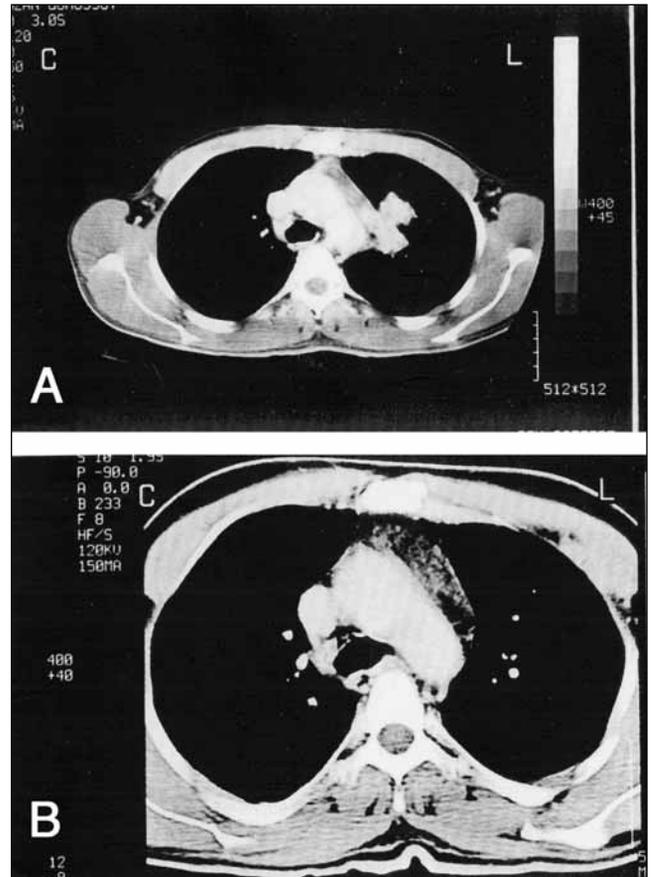


Figure 2 **A** Before treatment – computed tomography scan showing a 3 cm mass simulating bronchial carcinoma adjacent to left upper lobe bronchus and a 2 cm left hilar adenopathy; **B** After treatment – computed tomography scan showing complete resolution of previous radiological findings

in four patients and normal appearance in four patients. The location of the alveolar infiltration was the right upper lobe in 24 patients and the left upper lobe in 10 patients. Atelectasis was located in the right upper lobe in eight patients and in the left upper lobe in six patients. CT demonstrated patchy alveolar infiltration in 26 patients, atelectasis in 16 patients, cavitory lesions in nine patients, hilar adenopathy in six patients and mediastinal adenopathy in five patients. CT also revealed bronchial stenosis with wall thickening in eight patients and bronchial obstruction in six patients (Figures 1 and 2).

Tuberculin tests were positive in 46 patients. Results of leucocyte or lymphocyte counts and blood chemistry tests varied from normal to moderate or severely abnormal. Sputum smears were positive for acid-fast bacilli in six patients, and cultures were positive in 24 patients. Smears of bronchial lavage were positive in 11 cases, while lavage cultures were positive in 34 patients. Drug sensitivity tests were completed for 32 patients, but no multidrug-resistant strain was found. Histopathological examination of the bronchial biopsy specimens was compatible with tuberculosis in 39 patients.

Bronchoscopic examination revealed 89 endobronchial lesions of various types in 55 patients. The lesions were classified into exudative, granular, ulcerative, caseating and tumorous types according to the initial fiberoptic bronchoscopy findings. In the

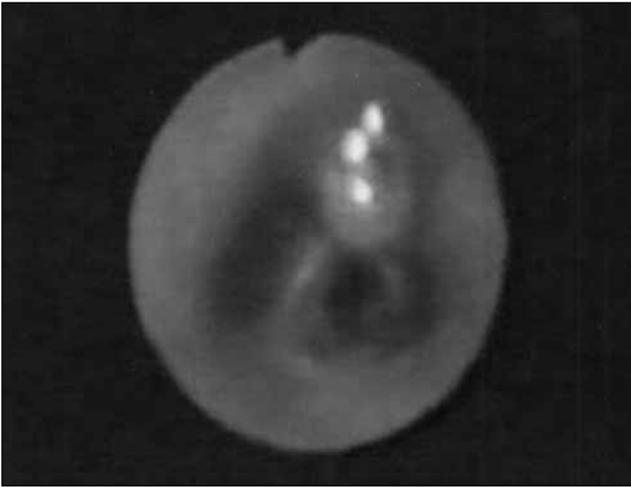


Figure 3) Tuberculous granuloma at the posterior wall of the proximal bronchus intermedius. The mucosa is swollen and red with an irregular surface

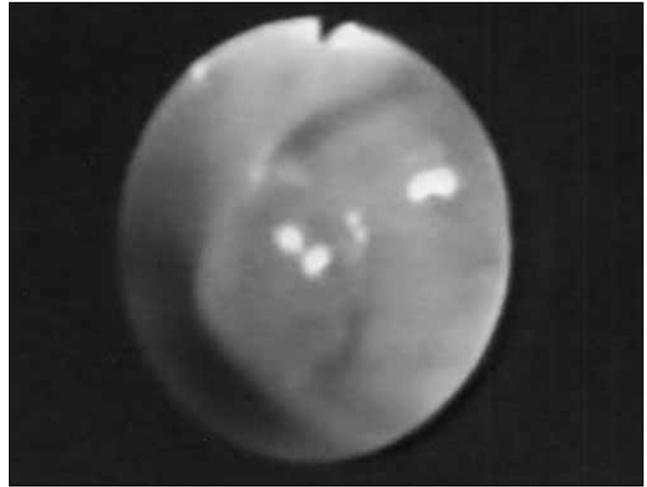


Figure 4) Tuberculous granuloma obstructing 50% of the lingular orifice. The overlying mucosa is red, swollen and obliterates the circular folds

exudative type, the bronchial lumen was narrowed due to mild to moderate swelling with surrounding edema. Granular lesions looked like scattered rice, with the underlying mucosa showing inflammatory changes. The ulcerative type of lesions was defined by the bronchial mucosa showing shallow or deep ulcerations. Caseating-type lesions were diagnosed when the mucosa was swollen, hyperemic and covered with whitish, cheese-like necrotic material. Tumorous endobronchial lesions were characterized by an endobronchial mass with moderate or severe bronchial occlusion. The surface was hemorrhagic and covered with caseous necrotic material simulating epidermoid lung carcinoma. None of the caseating- or tumorous-type lesions occluded more than 75% of the bronchial lumen.

The exudative-type lesion was the most common (n=24, 44%) form. The caseating (n=12, 22%) and tumorous (n=10, 18%) types were relatively common. Ulcerative- (n=5, 9%) and granular-type (n=4, 7%) lesions occurred less frequently. Bronchoscopic examination demonstrated two bronchopleural fistulas located in the right upper and left upper lobe orifices. Two submucosal granulomas were identified in the proximal bronchus intermedius and lingular bronchi (Figures 3 and 4). In 31 patients, only one type of endobronchial lesion was observed. While 14 patients had two different types of lesions, nine patients had three different lesion types in various combinations.

After treatment, fever, malaise, hemoptysis, anorexia and chest discomfort completely resolved. Sputum and cough were present in three (5%) and seven (12%) of the patients, respectively. Chest x-ray results were found to be normal in 43 patients, and bronchiectasis was present in four patients. Calcific and/or fibrotic lesions were observed in eight subjects. Follow-up bronchoscopy performed at the end of treatment revealed that exudative-, ulcerative- and granular-type lesions healed without any endobronchial sequelae. In eight patients, the tumorous type turned into the fibrostenotic type at the end of treatment. One-half of the caseating lesions healed with fibrostenosis. Bronchial stenosis was not more than 50% of the bronchial lumen in any of the patients. In patients with exudative-, granular- and ulcerative-type endobronchial lesions, CT changes returned to normal fol-

lowing treatment. Mediastinal and hilar adenopathies showed complete resolution. Bronchial wall irregularities were noted in seven patients, and bronchial obstruction was present in five patients. Bronchiectasis occurred in seven patients with tumorous lesions and in five patients with caseating lesions. Parenchymal and mediastinal calcific or fibrotic lesions were observed in 14 patients.

DISCUSSION

In adults, endobronchial tuberculosis may occur in primary or reactivation tuberculosis. The pathogenesis is not yet fully established. The possible mechanisms of endobronchial tuberculosis include direct extension from adjacent parenchymal infection, implantation of organisms from infected sputum, hematogeneous spread, lymph node erosion into a bronchus and lymphatic drainage from the parenchyma to the peribronchial region (2,4). With regard to the different pathogenic mechanisms, the clinical and bronchoscopic features of endobronchial tuberculosis vary. Recent studies have described various clinical symptoms in endobronchial tuberculosis. It may have an insidious onset, simulating lung carcinoma, or may be acute, mimicking asthma, foreign body aspiration or pneumonia (6-9).

The classical symptoms of endobronchial tuberculosis are cough, viscous sputum that is not easily expectorated, wheezing, fever, chest discomfort and hemoptysis. Our patients' symptoms on admission were persistent cough, malaise, sputum, fever, hemoptysis and anorexia. These symptoms, except hemoptysis, may be observed in various other respiratory diseases and are not useful for the early diagnosis of endobronchial tuberculosis. The most common subjective symptom at onset was persistent cough. Persistent cough is probably due to endobronchial inflammation. Fever reflects the progression of airway lesions and the inflammation of the lung parenchyma. Laboratory findings revealing inflammation and infection varied from normal to abnormal values, depending on the severity of the disease and the immune response of the host. Smear and culture positivity were low in our patients. This low yield on sputum smears is probably related to mucus entrapment by endobronchial lesions.

The radiological features of endobronchial tuberculosis also reveals many different patterns, including patchy alveolar infiltration, atelectasis, hilar enlargement, pleural effusion, mass and cavitary lesions. Interestingly, 10% to 20% of patients may present with normal chest radiographs (9,10). CT of the lung may provide more detailed information about the bronchial or parenchymal patterns of endobronchial tuberculosis, with better descriptions of hilar and mediastinal lymph nodes (11). Patchy alveolar inflammation of upper lobes and the presence of cavities were the most reliable features of endobronchial tuberculosis on chest roentgenograms in our patients. Interestingly, 7% of our patients had normal chest roentgenograms at the time of admission. Therefore, a clear chest roentgenogram does not exclude tuberculosis.

CT features correlated well with chest roentgenogram findings, while CT revealed endobronchial masses and enlarged mediastinal or hilar lymph nodes precisely. Parenchymal lesions were more clearly identified on CT scans. CT showed that areas of consolidation tend to be lobular in distribution. Multiple nodules of 2 mm to 10 mm in diameter involving several lobes, usually in an asymmetric fashion that represented the endobronchial spread of tuberculosis, were also noted. On CT scan, hilar or mediastinal lymph node enlargement (defined as a lymph node greater than 10 mm in short axis) was identified in 18% of the individuals. Cavitation was identified in 28% of patients by CT, compared with in 20% of patients by chest radiographs. Bronchiectasis was seen in 20% of the patients after treatment, which was apparent in only 9% of patients on chest radiographs. Bronchostenosis was found in 18% of the cases. Lee and Chung (12) have shown that chest CT is useful in demonstrating bronchial involvement and degree of stricture in endobronchial tuberculosis. CT features associated with stenosis in our patients were bronchial narrowing, uniform thickening, obliteration of bronchial walls by adjacent enlarged lymph nodes or distortion of the bronchial wall. After treatment, resolution of parenchymal or endobronchial lesions and enlarged mediastinal or hilar lymph nodes was clearly identified on CT scans, while on chest radiographs, only resolution of parenchymal consolidation or cavities could be detected.

Although bronchoscopic features of endobronchial tuberculosis have been described in previous studies, bronchoscopic findings may be variable due to the different pathogenic mechanisms and to the evolution of lesions at the time of bronchoscopy. The pathological changes of endobronchial tuberculosis are believed to begin as simple erythema and edema of the mucosa, accompanied by lymphocytic infiltration of the submucosa (13). This lesion is followed by submucosal tubercle formation (1). Progression to exudative and granular lesions with development of superficial ulcers may occur. Tumorous or caseating lesions may also develop, with eventual fibrosis and narrowing of the airways (2,14). Caseating and tumorous lesions with final bronchostenosis are findings of advanced disease (1,2,15,16). Our classification of bronchoscopic findings was related to the stage and extent of disease. Caseating and tumorous lesions were found to be indicative of an advanced stage, with eventual bronchostenosis in most of the cases. After treatment, all lesions except the caseating and tumorous lesions healed without any sequelae. Bronchial stenosis of varying severity occurred in one-half of the caseating and tumorous lesions.

The bronchial narrowing was not over 50% of the bronchial lumen. Bronchiectasis was noted to be a complication of caseating- and tumorous-type lesions.

Patient symptoms and chest x-ray findings were noted to be reliable guides for the assessment of therapeutic response. They were not useful for the detection of complications associated with endobronchial tuberculosis. When endobronchial tuberculosis is classified into five types, therapeutic outcome can be classified by bronchoscopy. Early stages, represented by the exudative, granular and ulcerative lesions, heal without any sequelae. In the caseating and tumorous lesions of advanced disease, bronchostenosis with eventual bronchiectasis may be a serious complication. We believe that bronchoscopy is a mandatory and reliable diagnostic procedure for the diagnosis of endobronchial tuberculosis. The bronchoscopist may discover various stages of endobronchial tuberculosis. Although none of our patients received steroid treatment, steroid therapy may be useful to prevent bronchostenosis in tumorous and caseating lesions identified by bronchoscopy. Follow-up bronchoscopy was not found to be necessary, except in caseating and tumorous lesions, which may result in bronchostenosis. CT can precisely detects consolidation, atelectasis, bronchial stenosis, bronchiectasis, lymph node enlargement, cavities and resolution of these lesions after treatment. We believe that CT may replace bronchoscopy for the assessment of therapeutic response and complications of endobronchial tuberculosis.

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