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Bronchial Anthracosis: A Potent Clue for Diagnosis of Pulmonary Tuberculosis

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Abstract

Objectives: Occupational exposure to carbon, silica, and quartz particles are predisposing factors for bronchial anthracosis. In some cases anthracosis may be associated with mycobacterium tuberculosis. This study aims to investigate the clinical, radiographic, and bacteriologic findings in bronchial anthracosis patients and its association with tuberculosis.

Methods: This is a prospective study conducted between 1998 and 2001. A total of 919 patients underwent diagnostic bronchoscopy for pulmonary diseases. Of these, 71 patients showed evidence of bronchial anthracosis, 32 (45.8%) males and 39 (54.2%) females, age range, 30-92 years. The distinctive clinical features, nature of bronchoscopic lesions, and radiologic findings were analyzed prospectively and summarized. Bacteriologic studies and results of laboratory examinations were also assessed.

Results: Forty-one (57.8%) patients had positive smears or cultures for mycobacterium tuberculosis. Of 71 patients with bronchoscopic evidence of pulmonary diseases, 30 had previous occupational exposure, and 41 stated no previous exposure. Cavitary lesions on chest radiography, positive purified protein derivative tests and high ESR were more prevalent in tuberculous patients than the others.

Conclusion: Bronchial anthracosis was caused by active or previous tuberculous infection. Detailed examinations for the presence of active tuberculosis should be performed in patients with such bronchoscopic findings in order to prevent the spread of tuberculosis and to avoid unnecessary invasive procedures.

Keywords: Bronchial anthracosis, pulmonary tuberculosis.

Introduction

Anthracosis is caused by the deposition of carbon, silica, and quartz particles in the macrophages, mucosa, and submucosa.[1] Occupational exposures to these particles are predisposing factors for bronchial anthracosis. In bronchoscopic view; dark lesions in normal or pathologic bronchial background are visible and the bronchi are highly fragile.[2,3] It is the black pigment discoloration of the bronchi, which can cause bronchial destruction and deformity.[4] In some cases, anthracosis may be associated with mycobacterium tuberculosis.

We have recently encountered an increasing number of patients where dark anthracotic pigmentation was not associated with environmental exposure to coal dust or smoking. Since many of these patients proved to have active tuberculosis on bacteriologic examination, identification of anthracosis on bronchoscopy leads to searching for evidence of active tuberculosis. There is some evidence relating to the coexistence of other disorders with anthracosis, hence there are few published papers which have reported the association between tuberculosis and anthracosis, while others believe that malignancy and tuberculosis are not more common in anthracosis and anthracofibrotic lung disease.[4] In addition, finding cases of anthracosis presenting with mediastinal lymph nodes mimicking tuberculous lymphadenitis or malignancy demonstrates the need for further study in this field.

This study aims to investigate the clinical, radiographic, and bacteriologic findings in patients with bronchial anthracosis.

Methods

From November 1998 to June 2001, a total of 919 patients (496 males and 423 females) underwent bronchoscopy at Baqyatallah Medical Center (Tehran-Iran) in a non-randomized prospective clinical study. All bronchoscopic studies were performed by two experienced pulmonologists. A questionnaire, consisting of personal and demographic data, occupational history, cigarette smoking, and clinical signs and symptoms, was filled out by all participants. Investigations that include CBC, ESR, purified protein derivative (PPD), chest X-rays, and chest CT scans (without contrast) were also taken.

Information regarding the lesions and their locations was recorded. Bronchial lavage (BL) was performed and samples were sent to investigate the presence of mycobacterium tuberculosis. In cases suspected for malignancy, biopsy from the lesions was also performed. Dynamic spirometry with flow volume curve (according to ATS standards) was performed for the patients.[5]

The patients were divided into two groups; a) With pulmonary tuberculosis and b) without pulmonary tuberculosis. Diagnosis of anthracosis was based on bronchoscopic findings as well as composition of the pigment in the lungs of patients. Unilateral pulmonary involvements were also separated from

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bilateral involvements. Patients with positive blood culture for mycobacterium tuberculosis were labeled as active pulmonary tuberculosis. While patients who had worked in mines, mills, or bakeries were classified under occupational exposure. Otherwise, they were included in the no risk factor group.

Radiologic views of Chest X-rays were classified as either normal or pathologic. CT scan findings were classified as atelectasis, collapse, lung mass, reticulonodular pattern, plural effusion, cavitation, diffuse calcification, patchy infiltration, or bronchiectasis. The PPD results were divided to 3 groups (according to WHO); Less than 5 mm was labeled as negative, between 5 and 9 mm as suspicious, and 10 mm or more as positive.

All analyses were performed using SPSS 11.5 (Chicago, USA). Data is presented as the frequency or mean ± SD. To compare demographic factors and match of groups, the t-test and Chi square tests were used.

Multivariate analysis was carried out using multiple Backward stepwise multiple logistic regression to assess the effect of various factors on the incidence of disease. To measure the association between two main variables, Odds ratio was calculated. A *p* value of less than 0.05 was considered to indicate statistical significance.

Results

Of the 919 patients who underwent bronchoscopy, 71 patients were diagnosed with anthracosis. Of these, 32 (45.81%) patients were males and 39 (54.2%) were females. The patient age was 68.2±10.7 years, while the age of patients without anthracosis was 52.2±17.4 years, which is significantly higher ($p<0.0001$). In patients with anthracosis, only 5 (5.2%) patients were aged under 40 years, 20 (20.8%) were aged between 40 and 65 years, while 71 (74%) were older than 65 years. The presenting signs and symptoms of the patients are shown in Table 1.

Forty-one (57.8%) of all anthracitic patients had tuberculosis, while 90 (10.6%) of all the non-anthracotic patients were affected by tuberculosis. Investigation of the probable effective factors on anthracosis by logistic regression showed that the female gender (OR=2.17) and a history of TB (OR=8.63) were significantly correlated with the disease, ($p<0.001$). The results also showed that each yearly increase of age lead to an increase of 1.07% risk of developing anthracosis among lung affected patients.

Proper spirometry was possible in 40 patients. Among these, 18 patients (46%) showed obstructive, and 5 cases (12.5%) showed restrictive patterns. A mixed pattern was seen in 11 (27%) cases and 7 (17.5%) had normal spirometry. The results of PPD and ESR tests are shown in Table 2.

Table 1: Sign and symptoms distribution

Sign	No. (%)	Symptom	No. (%)
Rales	34 (47%)	Cough	57 (80%)
Wheezing	17 (24%)	Productive	12 (17%)
Clubbing	4 (6%)	Non-Productive	45 (63%)
		Dyspnea	51 (72%)
		Hemoptysis	10 (15%)

Table 2: PPD and ESR result in studied patients

Test	No. (%) of patients	
PPD	With TB	Without TB
<5mm	5 (3.5%)	26 (18%)
5-9mm	3 (2%)	6 (4%)
>10mm	14 (10%)	17 (12%)
p value	$p<0.05$	$p<0.05$
ESR		
<20	2 (1.5%)	17 (12%)
20-100	14 (10%)	32 (23%)
>100	5 (3.5%)	2 (1.5%)
p value	$p<0.05$	$p<0.05$

Occupational exposure was present in 37 (38.5%) patients. Of these, 26 were bakers (27%) and 11 were miners (11.5%). In the other 59 patients, no occupational risk factors were found. Pulmonary tuberculosis was confirmed in 26 (36%) patients. Only eight patients from this group stated occupational risk factors. From the 26 cases with proven tuberculosis, eight patients stated a history of baking bread, two were cigarette smokers, and 16 had no occupational risk factors. The relation between radiologic findings and anatomical location of anthracosis, occupational information, and pulmonary tuberculosis are presented in Table 3.

Table 3: Radiologic findings and anatomical distribution in bronchoscopic view of the three groups with bronchial anthracosis.

	Radiological finding								Distribution		
	Atel	Ret	Mas	Patch	Eff	Cav	Bron	Cal	Diff	R Lung	L Lung
TB	5	4	10	10	3	4	4	2	15	8	3
Exp w/o TB	14	5	12	12	1	1	4	6	19	9	1
No exp or TB	14	5	9	9	13	-	1	3	22	12	7
P value	NS	NS	NS	NS	NS	$p=0.018$	NS	NS	NS	NS	NS

Exp= Exposure, Atel= atelectasis, Ret= retticulonodular, Patch=patchy infiltration, Eff= pleural effusion, Cav= cavity, Bron=bronchiactasis, Cal=calcification, Diff=diffuse, NS= no significant

Discussion

Endobronchial tuberculosis (EBTB) was found in approximately 58% of patients with anthracosis. These findings strongly suggest that bronchial anthracosis was caused by active or previous tuberculous infection. Endobronchial tuberculosis continues to be a health problem because diagnosis is frequently delayed. The low incidence itself diminishes clinical suspicion.[6,7] After establishment of EBTB, bronchostenosis may develop as a serious complication despite efficacious anti-tuberculosis chemotherapy.[8-11] It has been shown that EBTB may be misdiagnosed as bronchial asthma as it causes wheezing.[12,13] Approximately 24% of the studied patients who had this sign had been mistakenly treated for bronchial asthma for long periods before diagnosis. Radiological workup in 15% of the patients showed thoracic mass lesions in their CT scans, but no invasive procedures were performed until active lung tuberculosis was ruled out. Previous studies showed that by radiological investigations alone, bronchial anthracosis might be misdiagnosed as a lung cancer.[14,15] Most of the tuberculosis cases in this study showed an indolent course with slow progression during the years. The clinical course of EBTB is variable because interaction between the effect of mycobacteria, host immunity, and anti-tuberculosis drugs is complex, and any variation in these three factors may result in an altered course. For these reasons, the disease in some of these patients exacerbate after immunosuppressive therapy.[16]

In a study by Mirsadraee et al. dust exposure, malignancy, and tuberculosis were not found to be more common in anthracosis or anthracofibrotic lung disease.[4] There was no correlation between the patients and the control group in their study, which may be due to the fact that patient selection of both groups was from a region on the border of Afghanistan which has a high incidence of tuberculosis.

Traditional bread baking has been considered as a known occupational risk factor for the development of bronchial anthracosis. A study on African women has shown that smoke and silica inhalation caused by baking are effective in causing this lesion in the bronchi.[17] In another study, anthracofibrosis was present in 10/60 (16.7%) foreign-born patients who underwent bronchoscopy and had PTB in two cities in Canada. Compared to patients from other Asian countries, patients from the Indian subcontinent are more likely to develop anthracofibrosis (9/18, 50.0% vs. 1/26, 3.7%). Carbonaceous particles, silica and silicates were predominating in tissue specimens.[18]

Our study showed that the combination of bread baking and EBTB was present in a significant number of patients (8 out of 26 cases), and tuberculosis should be ruled out in such patients. This matter may be related to the fact that, inspiration of silica particles can suppress the activity of alveolar macrophages, thus reducing the body's tolerance against mycobacterium tuberculosis and causing an increased rate of lung tuberculosis in this population.[19] In a recent study in Iran, anthracosis and anthracofibrosis were reported as a common finding on routine bronchoscopic examination. Of the 14,300 patients, there were 487 cases of simple anthracosis, and 291 of anthracofibrosis. However, tuberculosis was not considered in this study.[20] Although bronchial anthracosis may be solely due to occupational risk factors or inspiration of soot like particles as Spencer described,[21] based on our results however, the association of some clinical clues such as high ESR, positive PPD test, and cavern patterns on chest radiograms should be considered as signs of active pulmonary tuberculosis until proven otherwise. It is also possible that anthracotic patients are more prone to TB than TB causing anthracosis.

Based on our study, the ESR and PPD tests were beneficial in predicting pulmonary tuberculosis. However, results may vary in other countries where the prevalence of tuberculosis is different. According to our results, anthracosis is more diffuse in the right lung, compared to left lung in all the studied patients. As a whole, diffuse anthracosis is more prevalent than the localized form in just one lung. Based on experience and findings from this current study, we recommend a trial of anti-tuberculosis therapy in symptomatic patients with bronchial anthracosis and ESR greater than 100 mm/hr., bronchial anthracosis restricted to one lung, or bronchial anthracosis with cavern lesions on chest radiography. These recommendations may prove useful particularly in developing countries.

Conclusion

Bronchial anthracosis was caused by active or previous tuberculous infection. Detailed examinations for the presence of active tuberculosis should be performed in patients with such bronchoscopic findings in order to prevent the spread of tuberculosis and to avoid unnecessary invasive procedures.

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