

Comparison of samples obtained from bronchoscopy of patients with and without bronchial anthracosis for investigating the prevalence of *Mycobacterium tuberculosis*

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Abstract

Objective Bronchial anthracosis is caused by the deposition of carbon, silica or asbestos particles in mucosal and submucosal cells and macrophages, and it can lead to chronic bronchial obstruction. Certain studies have reported an association between bronchial anthracosis and infection with *Mycobacterium tuberculosis*. This study aimed to compare the samples obtained from bronchoscopy of patients with and without bronchial anthracosis for investigating the prevalence of *Mycobacterium tuberculosis*.

Methods This was a cross-sectional study conducted between 2010 and 2013. A total of 514 patients underwent diagnostic bronchoscopy for pulmonary diseases. A sample of bronchoalveolar lavage fluid was taken from each patient and tested for *Mycobacterium tuberculosis* through smear and culture techniques. The data were analyzed with Chi-square and Fisher's exact test, with $p \leq .05$ set as the significant level.

Results Totally, 514 patients were evaluated through bronchoscopy; bronchial anthracosis was diagnosed in 207 cases, of which 129 (62.3%) were women. The rate of pulmonary tuberculosis was significantly higher ($p = .002$) in the bronchial anthracosis group.

Conclusion In our study, the prevalence of pulmonary tuberculosis was significantly higher in the bronchial anthracosis group. Given that pulmonary tuberculosis is still one of the health problems of the present century, increased attention to specific risk factors including bronchial anthracosis in patients having pulmonary symptoms is recommended.

Keywords Bronchial anthracosis, *Mycobacterium tuberculosis*, bronchoscopy

Introduction

Bronchial anthracosis (BA) is a bronchoscopic finding described by the advancement of dim pigments on airways and bronchial mucosa leading to bronchial damage, metamorphosis and obliteration.^{1,2} This process is a consequence of sedimentation of carbon, silica or asbestos

particles in the cytoplasm of mucosal and submucosal cells and macrophages in the respiratory tract.³ Bronchial anthracosis is a term commonly used to describe the parenchymal type of injury that develops when the removal of such particles is slower than their deposition.^{4,7} It is often asymptomatic and may potentially be found

Received: 20 April 2015; revised 17 June 2015; accepted: 13 August 2015

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Article downloaded from www.germs.ro
Published September 2015
© GERMS 2015
ISSN 2248 - 2997
ISSN - L = 2248 - 2997

in all urban dwellers due to air pollution.⁸ Occupational exposure to the abovementioned particles is a risk factor for bronchial anthracosis.^{9,10} When bronchial anthracosis spreads, the occlusion of the bronchial lumen can occur, with anthracofibrosis.¹¹⁻¹⁴ Previous studies have reported an association between tuberculosis (TB) and BA; in this context, patients with BA who experience worsening of the clinical state should be evaluated through bronchoscopy.¹⁵ It is also hypothesized that pulmonary TB could explain localized black lung and anthracosis in patients without a history of smoking or occupational exposure.¹⁵

Most patients with anthracotic bronchitis are elderly women who typically present with chronic cough, sputum and dyspnoea.^{15,16} In this study, we decided to carry out a research on samples obtained from bronchoscopy from people with and without bronchial anthracosis to study the incidence of acid-fast bacilli through smear and culture techniques.

Methods

In this cross-sectional study data was obtained from reviewing the files of 514 patients who underwent bronchoscopy in Shahid Sadoughi Hospital, Yazd, Iran during 2010-2013.

Bronchial anthracosis was characterized by dark pigmentations of the airway mucosa found during bronchoscopy.

For all patients, bronchoalveolar lavage (BAL) sampling (20 mL in 37°C) had been performed during bronchoscopy. During the duration of the project in a few turns a sampling from the equipment and the bronchoscopic room space was performed to identify mycobacterial and bacterial contamination; the results were negative. Then, samples were sent to the health center of Nikoopour (Centre for reference diagnosis of tuberculosis in Yazd) for culture and acid-fast staining. These steps are part of the standard operating procedure of the hospital. The laboratory supervisor was blinded to bronchoscopy results in terms of bronchial anthracosis.

IBM SPSS Statistics for Windows, version 19 (IBM Corp., Armonk, N.Y., USA) was used in

analyzing the data. Descriptive, Chi-square and Fisher's exact test statistics were used for data analysis. Finally, crude odds ratios (OR) were calculated using single variable logistic regression. All statistical tests were carried out at 5% (or .05) level of significance.

Results

In this study, of 514 people with respiratory symptoms who underwent bronchoscopy, 207 (40.2%) had anthracotic lesions in the bronchi (case group) and 307 patients (59.7%) did not have bronchial anthracosis (control group).

Bronchial anthracosis was significantly more common in women ($p = .001$) (Table 1).

Table 1. Gender distribution of patients in the anthracotic and non-anthracotic groups

	Male, no. (%)	Female, no. (%)	Total, no. (%)	<i>p</i> value
Bronchial anthracosis group	78 (37.7)	129 (62.3)	207 (100)	
Non-bronchial anthracosis group	182 (59.3)	125 (40.7)	307 (100)	.001
Total	260 (50.6)	254 (49.4)	514 (100)	

The mean age and standard deviation (SD) were 60.3±17.5 years, with a minimum of 11 years and a maximum of 94 years. The most frequent age group was 70 years.

In examining samples of BAL, of 58 people who, by definition, were affected by pulmonary tuberculosis, 34 (16.4%) were in the BA group and 24 (7.8%) were in the non-BA group. Pulmonary tuberculosis was significantly higher ($p = .002$) in the BA group (Table 2).

According to this study, exposure to TB was two-fold higher in people with bronchial anthracosis compared with normal cases. Also among 36 cases with smear-positive TB, 23 (11.1%) were in the anthracosis group and 13 (4.3%) in the non-anthracosis group.

In this study, 15 patients with BA and 9 cases in the non-BA group had a close contact with TB someone in their family. Six (25%) (2 in the BA group and 4 in the non-BA group) of these

patients during the study were affected by pulmonary tuberculosis. Twenty-two cases from the BA group and 12 cases in the non-BA group had a history of treated pulmonary tuberculosis; of these, 3 cases (8.8%) (2 in the BA group and 1 in the non-BA group) were determined to have pulmonary tuberculosis during the studied period.

Table 2. Distribution of pulmonary tuberculosis in the anthracotic and non-anthracotic groups

	Positive, no. (%)	Negative, no. (%)	Total, no. (%)	<i>p</i> value
Bronchial anthracosis group	34 (16.4)	173 (83.6)	207 (100)	
Non-bronchial anthracosis group	24 (7.8)	283 (92.2)	307 (100)	.002
Total	58 (11.3)	456 (88.7)	514 (100)	

In regard to the difference in the frequency of positive cultures in patients with a history of close contact with a person with tuberculosis (found in about 15% of cases), by integrating two other groups we compared the prevalence of TB in people with a history of tuberculosis and those without close contact with TB patients. This significantly showed that close contact with TB patients causes increased susceptibility to tuberculosis.

Since the number of people in contact with tuberculosis was higher in the bronchial anthracosis group, tentatively, eliminating those with a history of contact with TB led to a reduction in the incidence of tuberculosis in the bronchial anthracosis group from 16.4% to 15.1% that was still statistically significant ($p = .001$).

In this study, the incidence of tuberculosis in the non-Yazdi groups (the cities south of Iran) (15%) was higher than in patients from Yazd city (7.3%) ($p = .005$). Logistic regression showed that life place and bronchial anthracosis were main factors associated with pulmonary tuberculosis (Table 3).

Table 3. Statistical comparison of life place and bronchial anthracosis as main factors associated with tuberculosis

Variable	Variable Coefficient	Statistic	Odds ratio	95% confidence interval	<i>p</i> value
Life place*	.811	7.249	2.251	1.247 - 4.062	.007
Anthracosis	.844	8.727	2.326	1.329 - 4.072	.003

*Life place was defined as non-Yazdi (the cities south of Iran) vs. Yazd city

When analyzing bronchial anthracotic patterns in the bronchoscopies performed, the most frequently encountered was the bronchial anthracosis pattern without stenosis (66%); a significantly higher incidence of pulmonary tuberculosis was recorded in patients with stenosis ($p = .006$).

Discussion

The results of this study showed that 16.4% of bronchial anthracotic patients had tuberculosis; this value was significantly higher than that for the non-bronchial anthracosis control group.

Logistic regression showed that life place and bronchial anthracosis are main factors associated with pulmonary tuberculosis. These factors increase two-fold the chance of being infected with TB.

According to a study by Fekri et al., people with bronchial anthracosis had a 2.6 times greater risk of tuberculosis than healthy individuals (prevalence of TB was 6.9% and 2.7%, respectively). The correlation between BA and pulmonary TB was statistically significant.¹⁷ The findings from this study were consistent with those of our study. In another study, a total of 150 patients with BA were investigated. The most common complaints were dyspnea (38.7%) and productive cough (35.3%). At bronchoscopy, abnormal findings were seen most frequently in the right middle lobe bronchus. This study showed a significant correlation between bronchial anthracosis and pulmonary tuberculosis, 42 patients having

confirmed pulmonary TB.¹⁸ This study was also consistent with the results of our investigation. Another study investigated the correlation of bronchial anthracosis and tuberculosis. Of 919 patients who underwent bronchoscopy, 71 patients were diagnosed with bronchial anthracosis. In the BA group 57.8% of the patients had tuberculosis, compared with 10.6% in the non-BA group. This study was consistent with our findings.¹⁹

In a study on biomass smoke-induced bronchial anthracofibrosis, 22.5% of patients were diagnosed as having an acute exacerbation of obstructive airways disease. Among them, 16.8% had chronic obstructive pulmonary disease and 5.7% had bronchial asthma. Also, 33.9% of patients with bronchial anthracosis had pulmonary tuberculosis.²⁰ Our findings also showed that 16.4% of anthracotic patients had tuberculosis.

Conclusion

In our study, the prevalence of pulmonary tuberculosis was significantly higher in the bronchial anthracosis group. Given that pulmonary tuberculosis is still one of the health problems of the present century, increased attention to specific risk factors including bronchial anthracosis in patients having pulmonary symptoms is recommended.

Acknowledgements

The authors would like to thank the Infectious and Tropical Diseases Research Center of Yazd Shahid Sadoughi University of Medical Sciences for their kind assistance in performing this study.

Authors' contributions statement

All authors had equal contributions. All authors read and approved the final version of the manuscript.

Conflicts of interest

All authors – none to declare

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Please cite this article as:

Samet M, Ayatollahi J, Aboutorabi A, Rahimian M, Shahcheraghi SH, Mirjalili SA. Comparison of samples obtained from bronchoscopy of patients with and without bronchial anthracosis for investigating the prevalence of *Mycobacterium tuberculosis*. GERMS. 2015;5(3):78-82. doi: 10.11599/germs.2015.1074