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A Study on Relationship Between Anthracosis and Pulmonary Tuberculosis

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ABSTRACT

Background & Objective: Anthracosis is a bronchoscopic finding characterized by the presence of black pigments in the bronchial mucosa. In this study we examined the relationship between anthracosis and pulmonary tuberculosis in a sample size much larger than previous studies in order to alleviate the ambiguities and controversy surrounding this issue.

Materials & Methods: This cross-sectional study was conducted from April 2010 to October 2016 on patients referred to the hospital for bronchoscopy due to any respiratory problem. Bronchoalveolar lavage (BAL) was sampled during bronchoscopy and the smears and cultures of tuberculosis mycobacterium acquired from the samples were examined.

Results: In this study, 2377 patients were studied. The patients aged between 30 and 96 years, and of all patients, 1397 individuals were male. The prevalence of pulmonary tuberculosis among patients with and without anthracosis was 9.24% and 3.07%, respectively (P<0.001). The frequency ratio of females with anthracosis in comparison with males with anthracosis showed that the prevalence of this disease among females is higher than in males (P<0.001).

Conclusion: Pulmonary tuberculosis and anthracosis are related to each other and there is a direct relationship between the prevalence of pulmonary anthracosis and age and the female sex.

Keywords: Anthracosis, Bronchoalveolar lavage, Iran, Tuberculosis

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Introduction

Anthracosis is characterized by development of black pigments, probably associated with chronic environmental exposures causing bronchial damage and metamorphosis, observable by bronchoscopy on the airway surfaces and the bronchial mucosa (1). Anthracosis can cause endobronchial and parenchymal fibrosis, which is known as bronchial anthracofibrosis (2).

The increasing industrialization in the past decades and the consequent proliferation of contaminants such as carbon, asbestos, and silica in the air have changed the pattern of occupational diseases (3) making anthracosis one of the most prevalent occupational diseases; despite its decreased prevalence in recent years, it continues to stand out as the second important occupational disease (4). On the other hand, the prevalence of this disease in Asian countries, especially in rural areas, is on the increase (5). According to reports the prevalence of anthracosis among patients who underwent bronchoscopy is 4.2% (6).

Tuberculosis (TB), is an infectious disease caused by Mycobacterium tuberculosis and it can cause serious damages to the lungs (7). Most infections are asymptomatic and latent, yet out of every 10 infections, usually one will develop into active disease. Tuberculosis will kill 50% of patients if not treated. Experts believe that one third of the world population is infected with tuberculosis. Tuberculosis usually attacks the lungs, but it can affect other parts of the body as well. People with active tuberculosis infection can transmit the disease to others via their cough, sneeze, and saliva (8).

Pulmonary tuberculosis is one of the most important health problems in developing countries, where factors such as the emergence of AIDS have increased the importance of tuberculosis as serious threat to health.

Pulmonary tuberculosis is a chronic disease, and considering its need for specific kinds of treatment, it imposes heavy costs to the health system every year. A study conducted in Iran on 150 patients with anthracosis indicated that the prevalence of pulmonary tuberculosis in the patients with bronchial anthracosis is even higher (9).

Various studies have been conducted on bronchoscopy and autopsy samples to find the relationship between anthracosis and pulmonary tuberculosis, but due to the inconsistency in findings, this study was conducted on a larger sample size to assess the relationship between pulmonary tuberculosis and airways anthracosis and to answer the contradictions associated with this subject.

Materials and Methods

This cross sectional and retrospective study was conducted on the patients who underwent bronchoscopy due to any respiratory complaint between April 2010 and October 2016. In this study, medical charts of patients who underwent bronchoscopy in the six-year interval were used as information source. Written consent was acquired from all patients before bronchoscopy. The bronchoscopy was carried out by expert pulmonologists with the necessary skill and knowledge to diagnose pulmonary anthracosis.

The bronchoscopy device used in this study was Pentax-G120548 (made in Germany). Prior to bronchoscopy, all the patients received local anesthesia in the throat, and underwent oxygen therapy. Moreover, the electrical activity of heart and arterial oxygen percentage were monitored and recorded using the Novametrix pulse oxymeter (made in Germany) after insertion of a venous line.

All the patients' bronchoalveolar lavage was sampled during the bronchoscopy as a routine procedure at Afzalipour Hospital, Kerman, Iran; the acquired samples were used for smear and culture test of mycobacterium tuberculosis. The results of the tests of patients were extracted from their files in health centers to help in diagnosing pulmonary tuberculosis. The patients whose smear microscopy revealed tuberculosis mycobacterium under high power field of view were considered positive.

Samples were then placed in Lowenstein-Jensen growth medium (Bahar Afshan Co., Iran) for at least two months. The tuberculosis mycobacterium of the colonies grown in this medium was assessed and the results were recorded in patients' charts. Patients who had both positive smears and cultures or those who had only positive cultures were placed in the pulmonary tuberculosis group by a laboratory examiner unaware of the bronchoscopy results. The patients were divided into four groups according to infection with pulmonary tuberculosis and anthracosis:

1) Patients with pulmonary tuberculosis and anthracosis
2) Patients with pulmonary tuberculosis but without anthracosis
3) Patients with anthracosis but without pulmonary tuberculosis
4) Patients without anthracosis and pulmonary tuberculosis

Ethics Approval

This study was approved by the Ethics Committee of Kerman University of Medical Sciences (ethic code 94/75).

Statistical Analysis

Statistical analysis and univariate and multivariate logistic regression models were used to remove predicting factors. Moreover, Chi-square test was used for qualitative variables and analyses were done by SPSS 16 (SPSS Inc., Chicago, IL., USA). P-values less than 0.05 were considered statistically significant.

Results

In this study, the medical charts of 2377 patients who were underwent bronchoscopy in the Afzalipour Hospital in Kerman, Iran, were studied. More than half of the patients were males (n=1397, 58.7%). The age range of patients was 30 to 96. Our findings showed that 567 (23.9%) patients were diagnosed with anthracosis, and 102 (4.3%) were diagnosed with tuberculosis based on positive smear and culture. Table 1 illustrates the distribution of anthracosis and tuberculosis in patients. According to this Table, more than half of the male patients with tuberculosis also had anthracosis (n=17, 51%) whereas less than half of the females with tuberculosis also had anthracosis (n=31, 44.9%) (Table 1). The distribution of anthracosis patients and patients with both anthracosis and tuberculosis are expressed in Table 2. According to this table, with increase in age, the frequency of anthracosis patients and patients with both anthracosis and tuberculosis increased (Table 2).

In this study, 518 of patients had anthracosis (21.8 %, 95% CI: 20.1, 23.5), and the prevalence of tuberculosis in this population was 9.24 %. Only 48 patients had anthracosis and tuberculosis simultaneously (2.0%, 95% CI: 1.5, 2.6). Figure 1 shows the distribution of anthracosis and tuberculosis stratified by sex among patients.

The results of univariate logistic regression models for anthracosis showed that females in comparison to

males had more odds of anthracosis (OR: 2.16, *P*≤0.001). The results also revealed that patients with tuberculosis had higher chances of also anthracosis compared to those without tuberculosis (OR: 3.01, *P*≤0.001). Also females had greater odds of developing anthracosis compared to males (OR: 2.08, *P*≤0.001). According to this model, patients with tuberculosis had higher odds of developing anthracosis in comparison to those without tuberculosis (OR: 3.01, *P*≤0.001) (Tables 3 and 4).

According to the multivariate logistic regression model for anthracosis, older age (OR: 2.84, *P*≤0.001), female sex (OR: 2.09, *P*≤0.001), and positive tuberculosis (OR: 3.05, *P*≤0.001) were determined as predictors of anthracosis (Table 3). On the report of the multivariate logistic regression model for tuberculosis, younger age (OR: 0.69, *P*=0.01), female sex (OR: 1.79, *P*≤0.001), and positive anthracosis (OR: 3.36, *P*≤0.001) were identified as predicting factors of tuberculosis (Table 4).

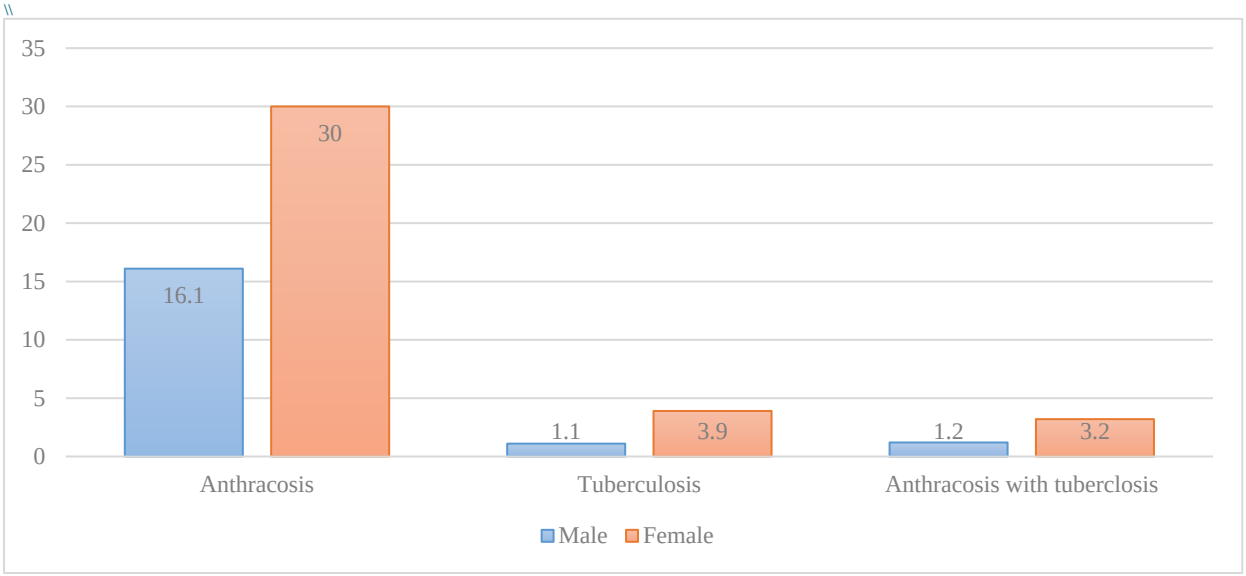

Figure 1. **The distribution of anthracosis and pulmonary tuberculosis in patients**

Table 1. **Comparison of pulmonary tuberculosis and anthracosis according to sex in the patients**

Variables	Disease status	Without anthracosis	Anthracosis
Male	tuberculosis	16(48.5)	17(51.5)
	without tuberculosis	1139(83.5%)	225(16.5)
Female	tuberculosis	38(55.1)	31(44.9)
	without tuberculosis	617(67.7)	294(32.3)
Total	tuberculosis	54(52.9)	48(47.1)
	without tuberculosis	1756(78.2)	519(21.8)

Table 2. **The distribution of age among patients with anthracosis, and anthracosis with tuberculosis**

Age groups	Only- anthracosis	Anthracosis with tuberculosis
30-39 years	6(0.9)	0(0.0)
40-49 years	14(2.5)	2(4.2)
50-59 years	93(16.4)	5(10.4)
60-69 years	149(26.3)	6(12.5)
70-79 years	181(32.0)	21(41.7)
80-89years	119(21.0)	14(29.2)
More than 90 years	5(0.9)	1(2.1)

Table 3. **The univariate and multivariate logistic regression models to determine the predictors of anthracosis among patients**

Variable	Variables level	Crud Odds Ratio (95% CI)	P-value	Adjusted Odds Ratio (95% CI)	P-value
Age		2.78 (2.39-3.23)	<0.001	2.84 (2.43-3.32)	<0.001
Sex	Male	1	<0.001	1	<0.001
	Female	2.16 (1.78-2.62)		2.09 (1.70-2.56)	
Tuberculosis	Negative	1	<0.001	1	<0.001
	Positive	3.01 (2.01-4.49)		3.05 (1.96-4.74)	

95 %CI: Confidence Interval OR: Odds Ratio

Table 4. **The univariate and multivariate logistic regression models to determine the predictors of tuberculosis among patients**

Variables	Variables level	Crud Odds Ratio (95 % CI)	P-value*	Adjusted Odds Ratio (95 % CI)	P-value*
Age		0.93 (0.71-1.22)	0.63	0.69 (0.51-0.93)	0.01
Sex	Male	1	0.001	1	<0.001
	Female	2.08 (1.41-2.08)		1.79	
anthracosis	Negative	1	<0.001	1	<0.001
	Positive	3.01 (2.01-4.49)		3.36 (2.15-5.23)	

*CI: Confidence Interval OR: Odds Ratio

Discussion

This study indicated that there is a significant relationship between pulmonary tuberculosis and anthracosis, and that the prevalence of pulmonary tuberculosis among the patients with anthracosis was 9.24%, which had been reported to be 6.9% in a similar study with a smaller sample size (10). This relationship was reported as 30.2% and 27% in two other studies with much smaller sample sizes (11, 12). One systematic review showed that the frequency of tuberculosis in anthracosis patients was 22.5% (13). The difference between the frequency reported in these studies and the results of the present study could be due to the smaller sample size of the aforementioned studies.

On the other hand, some studies have mentioned tuberculosis as the reason for pulmonary anthracosis. This means that although most patients with anthracosis did not have the history of having contact with dust or smoke, a significant percentage of them had active pulmonary tuberculosis, and it is said that the anthracotic materials in the lymphatic nods of patients with pulmonary tuberculosis (located in the vicinity of the bronchi) would gradually open to it and serve as the source of bronchial anthracotic pigments (11, 14). In spite of this, a study conducted in Iran indicated that there is no relationship between pulmonary tuberculosis and anthracosis (15). Moreover, another study conducted in China demonstrated that the correlation between pulmonary tuberculosis and anthracosis is very rare (16).

According to the findings of the present study, the frequency ratio of female patients with anthracosis to male patients with anthracosis was 1.34:1. These results showed that the prevalence of anthracosis in females is higher, and there are other studies where this ratio has been reported to be 1.33:1 and 1.42:1 (17, 18), which shows a higher prevalence of anthracosis among females. In a similar study, the prevalence of pulmonary anthracosis in males was 0.4 compared to females, which again indicates a higher prevalence of pulmonary anthracosis among females (10). The results of some studies suggest that the higher prevalence among women may be due to the use of fossil fuels by females at home (19, 20).

According to the results of the present study, the prevalence of anthracosis significantly increased with the increase in age. In other studies, the average age of patients with anthracosis has been reported to be higher in comparison with the patients without anthracosis, and it is said that the highest frequency of anthracosis has been observed in seventy-year-old patients (11, 17, 18).

Conclusion

Considering the demonstrated relationship between anthracosis and pulmonary tuberculosis, the presence of anthracosis in the bronchoscopy may indicate the need for more diagnostic surveys for detecting pulmonary tuberculosis and preventing the further spread of this contagious and lethal disease.

Meanwhile, since airway anthracosis is more common among females and consequently, pulmonary tuberculosis is more common among them, it is suggested that home ventilation and cooking methods be optimized and improved; a reduction in the use of fossil fuels may also play an important role in preventing these disabling diseases.

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Conflict of Interest

Authors declared no conflict of interest.

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