

# Anthracosis of the Lung: Evaluation of Potential Causes

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## Abstract

Anthracosis is black pigment discoloration of bronchi which can cause bronchial destruction and deformity (anthracofibrosis). A prospective, case-control study was performed to evaluate potential underlying causes of anthracosis on 190 subjects who referred for various indications. Age of patients ranged from 10-85 yrs. 46% of male patients were farmers and 27% were manual workers, whereas 91% of female patients were housewives. During bronchoscopy, special attention was given to anthracotic plaque, bronchial deformity, infiltration, or vegetation. Broncho-alveolar lavage was performed for further cytopathological, acid-fast bacilli staining (AFB) and culture in all cases. No correlation between occupational exposure to dust and two kinds of anthracosis (anthracotic plaque and anthracofibrosis) was present. In anthracofibrotic patients, 81% were non-smokers. The principal finding in bronchoscopy was simple plaque of anthracosis in 21% and anthracofibrosis in 12%. Sputum smear showed macrophages containing anthracotic granules in 71%. Patients with anthracosis had positive histopathology for tuberculosis (21%) that was not significantly different from subjects without anthracosis. Of 40 patients with simple anthracotic plaque and 22 with anthracofibrosis, only two and one patients, respectively were proven to have bronchogenic carcinoma that was not statistically more common than in the control group. Other etiology for anthracofibrosis should be investigated.

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**Keywords** • Anthracosis • anthracofibrosis • occupational lung disorders • cigarette smoking • lung cancer

## Introduction

**A**nthracosis is black pigment discoloration of bronchi and can cause bronchial destruction and deformity (anthracofibrosis).<sup>1</sup> Anthracosis is considered as a benign bronchial finding during bronchoscopy and it is a rare finding in developed countries. There is anecdotal evidence that this disease is increasing in prevalence in our region. This disease is a major cause of obstruction in large bronchi and can make severe respiratory symptoms such as cough, dyspnea and tendency for infections<sup>1</sup>. Histopathology findings are anthracotic granule inside and outside of macrophages, and edema and scattered inflammatory cells. The term anthracosis had usually been used for coal miners and rarely in city dwellers, but in experience of some physicians this disease was not associated only with environmental exposure or smoking.<sup>2</sup> Infectious disease and malignancies were implicated as background

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of anthracosis.<sup>1,2</sup> The objective of this study was to study the relationship between anthracosis and the above predisposing factors.

**Patients and methods**

This study was approved by Ethical Committee of Research Office of Medical School of Islamic Azad University of Mashhad, Mshhad, Iran, and a written consent was obtained from all patients. A prospective case-control study was performed in tertiary Mashhad university Hospitals. All patients who had flexible bronchoscopy for various indications were considered for the study. Demographic data and clinical findings were recorded. During bronchoscopy, special attention was given to anthracotic plaque, deformity, infiltration, vegetation and standard bronchoalveolar lavage. Biopsy was taken for histopathology examination when malignancy or granulomatose disease was suspected during bronchoscopy. Bronchial smear was taken for the assessment of acid-fast bacilli (AFB).

Standard broncho-alveolar lavage (BAL) was performed in all patients and their cytology specimens were examined for macrophage containing anthracotic granule and bronchial smear for acid fast bacilli (AFB) and culture (Levinstein Johnson media). Patients with three or four positive smears for AFB or positive culture for *mycobacterium tuberculosis* and caseous necrotizing granuloma in biopsy considered to have tuberculosis. Students' t test was used to compare the results and  $p < 0.05$  was considered as statistically significant.

**Results**

One hundred and eighty nine patients underwent bronchoscopy (95 male and 94 female), aged from 10-85 yrs ( $60 \pm 16$  yrs). Simple plaque of anthracosis was found in 21% and anthracofibrosis in 12% the patients. Gross bronchoscopic findings in simple anthracosis included a patchy flat black discoloration of large bronchi and circular contiguous black discoloration in small visible bronchi. Contrast anthracofibrosis showed that the edema and infiltration of sub mucosa were the cause of occluded bronchi, whereas their surface epithelium was shinny without having ulceration. In sputum smears of 71% of the patients the observed macrophages contained anthracotic granules.

*Occupation*

The majority of male patients were farmers (46%) and manual workers (27%), whereas, 91% of female patients were housewives. No correlation was observed between occupational exposure to dust and the two kind of anthracosis

(anthracotic plaque and anthracofibrosis), or tuberculosis and occupation.

*Clinical findings*

The main presenting complaint of the patients who had bronchoscopy was cough (92%), dyspnea (69%) and hemoptysis (28%). None of these symptoms has statistical correlation with any kind of anthracosis (Table 1).

**Table 1:** Correlation of clinical findings to major disease entity

	ANT (%)	TB (%)	Smoking (%)	Cancer (%)
Cough	100	94	92	100
Dyspnea	71	62	75	75
Hemoptysis	32	17*	30	29
VCP	27*	15	13	16

VCP= Vocal cord paralysis; ANT=Anthracofibrosis; TB=Tuberculosis \* =  $p < 0.05$

*Smoking*

Positive smoking history was considered as smoking of cigarette, water pipe and pipe. Smoking was more prevalent in male patients, and inversely related to tuberculosis ( $p < 0.02$ ). Smoking status was not related to major symptoms and any kind of anthracosis. Amongst anthracofibrotic patients, 81% were nonsmokers.

*Relation of anthracosis and tuberculosis*

Active tuberculosis was found in 30% of patients of whom 22 patients had positive sputum smears, 25% had positive cultures and tuberculosis was confirmed in 17% of these patients. The incidence of tuberculosis in two forms of anthracosis presentations are shown in Table 2. In 21% of the patients, anthracosis had positive histopathology of tuberculosis. No significant correlation was found between anthracofibrosis and tuberculosis.

**Table 2:** Prevalence (PR) of anthracosis (Anth), anthracofibrosis (Anthf) and some major risk factors.

	Risk factors	PR (%)	P Value
Anth	Smoking	68	0.338
	Cancer	75	0.487
	TB	72	0.389
Anthf	Smoking	6	0.054
	TB	19	0.081
	Cancer	4.2	0.21
	HRO	7	0.71

HRO = High risk occupation

*Relation of anthracosis with bronchogenic carcinoma*

The principle finding of bronchoscopy was vegetation in 40%. In patients who underwent biopsy, 21% of them had malignancy in histopathology. In 40 patients with simple anthracotic plaque and 22 anthracofibrosis, only two and one

patient, respectively, were proved to have bronchogenic carcinoma that was not statistically significant (Table 2).

## Discussion

Anthracosis, as an occupational disease, is black pigmentation of bronchi, which is known as anthracofibrosis if leads to bronchial destruction and deformity.<sup>1</sup> Although, anthracofibrosis is reduced in Western industrial countries, it is still widespread in some third world countries.<sup>4</sup> Chung et al. reported anthracofibrosis in 3% of routine bronchoscopies,<sup>1</sup> whereas, we found 21% simple anthracosis in routine bronchoscopies. Anthracofibrosis can distort bronchial lumen and cause clinical problem and is the most important form of pulmonary anthracosis. In addition to lung, Anthracosis may involve lymphoreticular organs and liver.<sup>5,6</sup> For elucidation of origin of anthracosis, Tanaka et al.<sup>6</sup> performed special bronchoscopic study in small bronchi and concluded that peripheral airways are the initial site of anthracotic granule production.

Because many patients with anthracosis were not exposed to air dust at work, other investigators studied other possible causes of anthracosis. Muliez et al.<sup>2</sup> reported three patients with anthracosis that proved to have Mica in lung biopsy material that might be associated with domestic pollution. Kato and his colleague examined the effect of polluted roadside air on rats during 60 weeks.<sup>8</sup> Their findings suggested that the effect of roadside air on the respiratory tissue causing anthracosis may not be as severe as it was expected under this experimental condition.<sup>8</sup>

In order to characterize the relationship between background anthracosis and pulmonary carcinogenesis, some investigators studied the association of anthracosis and lung cancers, especially to adenocarcinoma.<sup>3,9</sup> They concluded that adenocarcinoma developing in heavily anthracotic lungs readily progresses to an advanced stage, or that adenocarcinoma with a less favorable prognosis tends to develop in severely anthracotic lungs.<sup>9</sup>

According to our results anthracotic plaque was a prevalent finding in bronchoscopy (21%), in comparison to other country such as Korea where this disease is reported to be present in 3.7% of 908 routine bronchoscopies.<sup>1</sup> Female gender was more prevalent (68%) in the reports of Chung et al.<sup>1</sup> Amoli, et al. reported that non-smoker elderly housewives with chronic bronchial anthracosis had anthracotic plaque with past history of prolonged exposure to smoke whilst baking household rustic bread inside dwelling.<sup>4</sup> However, in our study as well as the

study of Chung et al. 71% and 81% of the patients with anthracofibrosis were nonsmokers. Therefore, we think smoking habit is not the prime risk factor.

In our patients anthracosis was not related to occupational exposure to dusts. Moreover, most of our patients lived in countryside and had little exposure to air pollutions. Therefore, we think occupational exposure is a risk factor for induction of anthracosis. We also studied infectious etiology of anthracosis, particularly tuberculosis, but could not correlate it as a prevalent risk factor as reported previously.<sup>1</sup> It is interesting to mention that the biopsy of anthracofibrotic patients proved that they were suffering from tuberculosis but it failed to show typical granuloma formation. However, anthracosis should be investigated in people who are regularly exposed to environments with mineral dusts, smokes from incomplete burning of plants, or diesel fuel combustions.

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