ORIGINAL ARTICLE *Turkish Respiratory Journal* 2007; 8(2): 48-51

Occupational and Environmental Lung Diseases

Bronchial Anthracostenosis in Patients Exposed to Biomass Smoke

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Abstract

Study Objectives: To evaluate the clinical, radiological and bronchoscopic features of 27 patients with anthracostenosis. **Design**: All patients with anthracostenosis determined by bronchoscopic examinations between 2002 and 2005 were considered in this retrospective study. Anthracostenosis was defined as anthracotic pigment deposition and the narrowing of one or more bronchial orifice in cases with no history of smoking or occupational exposure to dust. **Results**: Of the 27 patients, 25 were female and two male. The mean age was 66.8 (53-77) years. The 27 patients who were exposed to biomass fuel had a mean exposure of 39.3 (10-70) years. With one exception, all cases had abnormal radiological findings in their posteroanterior chest x-rays. The most frequent thorax CT finding was segmental or subsegmental atelectasis (n=20, 74.1%). Histopathologic examinations revealed anthracosis in 13 cases, inflammatory cell deposition in 10 and granulomatous inflammation in two. Active tuberculosis was detected in 7 cases (25.9%). No malignancy was found in any of the patients. **Conclusions:** Bronchial anthracostenosis is a clinical presentation caused by biomass exposure and is encountered most commonly in older females. Nationwide measures should be taken to prevent biomass fuel pollution.

Key Words: Anthracosis, anthracostenosis, biomass smoke

Received: Dec 21, 2006 Accepted: Jul 18, 2007

INTRODUCTION

Indoor air pollution resulting from combustion of biomass fuels (coal, wood, animal dung or chaff, straw and other byproducts of crops) is an important risk factor for chronic lung diseases in developing countries, especially for women [1, 2]. Nearly fifty percent of world population relies on biomass fuel for cooking, heating or illumination [3]. It has been shown that the risk of acute respiratory tract infections, chronic obstructive lung disease, cancer and tuberculosis is increasing in conjunction with the use of biomass [2-9]. Other bronchopulmonary disorders that some researchers attribute to biomass usage are anthracosis in cases with no history of smoking or occupational dust exposure and stenosis, or obliteration of the lobe and segment orifices due to anthracosis [10]. It is also reported that tuberculosis causes this presentation [11]. Recently, anthracofibrosis was defined as anthracotic pigment deposition in conjunction with narrowing or obliteration of one or more bronchial orifice as observed during bronchoscopic examination in cases with no history of environmental such as coal dust or smoking exposure [11,12] (figure 1). Herein, we are introducing antrhacostenosis due to biomass exposition.

MATERIAL AND METHODS

In this study, clinical and radiological features of 27 cases with anthracostenosis determined during bronchoscopic examination were retrospectively evaluated. All patients who had flexible bronchoscopy for various indications between January 2002 and October 2005 were considered for the study. Anthracostenosis was detected in 27 cases. Olympus BF type T-240 bronchovideoscope was used for the procedures and the views were recorded. In all cases, sputum or bronchial washing fluids were evaluated for tuberculosis by direct smear examination or culture. Biopsies were performed using endobronchial forceps when malignancy or granulamatous disease was suspected during bronchoscopy. Demographic data and clinical findings were recorded. A brief questionnaire including the exposure of biomass smoke at home, type of fuel used, duration of exposure and tobacco smoking was applied to each patient. Posteroanterior (PA) and lateral chest x-rays and computerized tomographies (CT) of the thorax of were obtained in all patients.

RESULTS

Of the patients, 25 were female and two were male. The mean age was 66.8 (range 53 to 77) years. None of the cases had a history of smoking. All the female patients were housewives with one exception; a cigarette factory worker. Both male patients were farmers. All 27 of patients who were exposed to biomass fuel and had a mean exposure of 39.3 years (range 10 to 70). Wood, animal dung and crop residues were used as fuel, with winter time exposure being especially heavy because of the usage of open ovens for cooking or heating in poorly ventilated confined spaces at least once a week but more often every day. Four cases were

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Table 1. Bronchoscopic findings of 27 patients

	Number of cases	Localization				
		Right			Left	
		Upper Lobe	Middle Lobe	Lower Lobe	Upper Lobe	Lower Lobe
Anthracosis	27	25	22	20	18	16
Bronchial narrowing	27	14	10	1	9	3
Endobronchial mass	1	-	-	1	-	-
Irregular mucosa	4	-	-	3	-	-

still exposed to biomass fuel at the time of admission. In 23 cases (85.2%), exposure to biomass fuel ended a mean of 26 (range 7 to 50) years before admission. In all cases, no source of air pollution except biomass fuel that could be identified in the etiology. Three cases had histories of tuberculosis treatment.

The most common complaints were cough (n=27, 100.0%), sputum production (n=22, 81.5%) and dyspnea (n=17, 63%). Hemoptysis was seen in 8 cases (29.6%), weight loss in 7 cases (25.9%) and fever was present in 1 case (3.7%). In 5 cases (18.5%) hypertension and in 1 case (3.7%) diabetes mellitus were present.

With one exception, all cases had abnormal radiological findings in their PA chest x-rays. The radiological findings were atelectasis in 13 cases (48.1%), linear shadows in 11 cases (40.7%), consolidation in 8 cases (29.6%), reticular or reticulonodular pattern in 7 cases (25.9%) and mass in 2 cases (7.4%) (Table 2).

The most frequent thorax CT finding was segmental or subsegmental atelectasis (n=20, 74.1%). Other CT findings were linear banding in 14 cases (51.9%), mediastinal or hilar lymphadenopathy (LAP) in 8 (29.6%), mass in 7 (25.9%), interstitial pattern in 3 (11.1%), bronchiectasis in 3 (11.1%), nodules in 6 (22.2%), calcification in 6 (22.2%) and consolidation in 2 cases (7.4%) (Table 3).

The characteristic appearances in bronchoscopic evaluation were multiple anthracotic plaques at main, lobar and segmental bronchus, and narrowing at the lobar and segmental bronchus. Bronchoscopic appearances and their localizations are shown in Table 1.

Endobronchial forceps biopsy was performed in all except two cases. Histopathologic examinations revealed that anthracosis existed in 13 cases, inflammatory cell deposition in 10 and granulomatous inflammation in two cases.

Direct examination of sputum in two case and of bronchial washing fluid in another case showed the acid fast bacillus to be positive. *M. tuberculosis* cultures were positive in 7 cases.

Table 2. Principal Findings of Chest Radiography of 27 patients.

Radiologic findings	No. of patients	%
Atelectasis	13	48.1
Linear shadow	11	40.7
Consolidation	8	29.6
Reticular or reticulonodular pattern	7	25.9
Mass	2	7.4

While active tuberculosis was detected in 7 cases (25.9%), the histopathological examinations revealed malignancy in none of the patients. In 13 (48.1%) cases, the results of tuberculin skin tests were 10 mm or above.

Pulmonary function tests in ten (37%) patients showed a decreased FVC from 40- 66% of the predicted value and the ratio FEV1/FVC ranged 51-72%. Patients were followed a mean of 27 months (range: 10 to 48 months). Symptomatic patients received therapy directed to their complaints. Patients with tuberculosis were treated according to national tuberculosis guideline. One patient died with respiratory failure.

DISCUSSION

Biomass including wood and dung is widely used for fuel in many rural areas of Anatolia. Most of heating and cooking is done by burning wood, dung and crop residues in traditional fireplaces, called "tandır", set into an opening in the wall with a chimney [5, 13]. Tandır's typically heat a small room where the family congregates in cold weather. So, family members have been intensively exposed to biomass fuel smoke and particles since birth. Women and young children in their care are especially exposed to this smoke and these particles because of the use of biomass fuel for cooking, which is a task women perform. Babies and very young children are usually in the same environment. Recent studies conducted in rural Turkey, support the view that biomass smoke pollution is an important contributing factor in the development of chronic bronchitis and chronic airway obstruction in nonsmoking women [5, 14]. Many studies in various areas of the developing world emphasize that women and children are at greatest risk from the health effects of biomass fuel pollution [4, 10, 15].

Bronchial anthracofibrosis was first defined by Chung et al. In their study of 28 cases, they found 61% were active tuberculosis cases [11]. In Kim et al.'s study, the number of cases was 54 and the active tuberculosis case ratio was 59% [12]. These researchers defined anthracofibrosis as a clini-

Table 3. Radiologic findings on Chest CT

Radiologic findings	No. of patients	%
Segmantal or subsegmental atelectasis	20	74.1
Linear banding	14	51.9
Mediastinal or hilar lymphadenopathy	8	29.6
Mass	7	25.9
Nodules	6	22.2
Calcification	6	22.2
Interstitial pattern	3	11.1
Bronchiectasis	3	11.1
Consolidation	2	7.4

cal finding resulting from tuberculosis because it presents similar radiological findings to tuberculosis and is strongly associated with tuberculosis without environmental exposure. If an environmental exposure take place such as working in the mine exposing charcoal dusts, this pathology has recently been defined as anthracostenosis [16]. Another factor that can be of etiological importance to anthracostenosis is long-term biomass exposure. Amoli studied 10 cases with bronchopulmonary changes defined as diffuse anthracotic pigment deposition at main bronchus, lobar and segment bronchus together with narrowing the bronchus. None of these cases had active tuberculosis, leading Amoli to attribute these presentations to chronic household smoke exposure [10]. Sandoval et al. also reported an association between biomass fuel exposure and anthracosis. These researchers found anthracosis and abnormal radiological findings in 14 cases out of 22 that underwent bronchoscopy and they attributed these findings to biomass fuel exposure [7].

In our series, 85.2% of the patients were living in urban areas, but all 27 cases lived a mean of 39.3 years in rural areas of Anatolia and all were exposed to heavy smoke regularly. In Turkey there has been intensive internal migration from central Anatolia to Istanbul for many decades. Thus, many people with previous biomass exposure now live in Istanbul and these people can benefit from health care services easily. The rural origin of the patients may remain unknown due to immigration to cities. Almost all cases were elderly or midlle aged women.

All cases were admitted with respiratory complaints and all except one had abnormal chest x-rays results. Radiological findings were nonspecific. The most common CT finding was segmental atelectasis. Differential diagnosis of these cases and the determination of stenosis and endobronchial lesions from bronchoscopic procedures frequently raised suspicions of malignancy. The main diagnostic tool was bronchoscopic evaluation. As bronchial narrowing with

Figure 1. Anthracostenosis; anthracotic pigment deposition with narrowing or obliteration of bronchial orifice.

distal atelectasis and mediastinal lymphadenopathy suggest malignancy, the recognition of anthracostenosis is important to avoid thoracotomy.

In Turkey, the incidence of tuberculosis is approximately 26 per 100 000 [17], which is relatively high compared with that of more developed countries. This high rate and the high proportion of the population sharing living and sleeping space in cramped one- or two-roomed houses, makes it a reasonable supposition that tuberculosis coincident in our study cases. On the other hand, not determining anthracofibrosis which can mimic anthracostenosis in cases with tuberculosis in bronchoscopic experiences is an important point. We detected no anthracofibrosis in our series of 40 patients with endobronchial tuberculosis [18]. Anthracofibrosis was reported only in 3 patients in an endobronchial tuberculosis series consisted of 114 cases done in Korea [19].

It has been shown experimentally that chronic smoke exposure affects the mucociliary defense mechanism of the lung and reduces the antibacterial activity of macrophages [8]. A relationship between tuberculosis and the use of biomass fuel is theoretically possible. This link may result from physical damage to the lungs rendering them susceptible to infection, or from suppression of the immune system. Mishra et al. reported in their study that tuberculosis is more frequent in people exposed to biomass fuel pollution than in people not so exposed [20]. Padilla et al. observed that biomass fuel pollution exposure was more frequent in cases that had active tuberculosis than in control cases [6].

Ten percent of the patients had a decreased FVC. Behera et al. (1994) showed that lung functions, particularly FVC, are affected by indoor air pollution due to domestic cooking with biomass fuel [21].

As a result, bronchial anthracofibrosis and anthracostenosis are clinical entities due to biomass exposure and are encountered most commonly in older females. In the areas of Turkey where biomass is used, the diagnosis of anthracostenosis should be considered before malignancy in patients who do not smoke, thereby avoiding unnecessary thoracotomies. More importantly, nationwide measures should be taken to prevent biomass fuel pollution.

ACKNOWLEDGEMENTS

The authors thank Adrian Higgs for editorial assistance.

REFERENCES

1. Dennis RJ, Maldonado D, Norman S et al. Wood smoke exposure and risk for obstructive airways disease among women. Chest 1996;109:115-9.
2. Bruce N, Perez-Padilla R, Albalak R. Indoor air pollution in developing countries : a major environmental and public health challenge. Bull World Health Organ 2000;78:1078-92.
3. Viegi G, Simoni M, Scognamiglio A et al. Indoor air pollution and airway disease. Int J Tuberc Lung Dis 2004;8:1401-15.
4. Albalak R, Frisancho AR, Keeler GJ. Domestic biomass fuel combustion and chronic bronchitis in two rural Bolivian villages. Thorax 1999;54:1004-8.
5. Ekici A, Ekici M, Kurtipek E et al. Obstructive airway diseases in women exposed to biomass smoke. Environ Res 2005;99:93-8.
6. Perez-Padilla R, Perez-Guzman C, Baez-Saldana R, Torres-Cruz A. Cooking with biomass stoves and tuberculosis: a case control study. Int J Tuberc Lung Dis 2001;5:441-7.
7. Sandoval J, Salas J, Martinez-Guerra ML et al. Pulmonary arterial hypertension and cor pulomonale associated with chronic domestic woodsmoke inhalation. Chest 1993;103:12-20.
8. Smith KR, Samet JM, Romieu I, Bruce N. Indoor air pollution in developing countries and acute lower respiratory infections in children. Thorax 2000;55:518-32.
9. Ezzati M, Kammen DM. Indoor air pollution from biomass combustion and acute respiratory infections in Kenya: an exposure-response study. Lancet 2001;358:619-24.
10. Amoli K. Bronchopulmonary disease in Iranian housewives chronically exposed to indoor smoke. Eur Respir J 1998;11:659-63.
11. Chung MP, Lee KS, Han J et al. Bronchial stenosis due to anthracostenosis. Chest 1998;113:344-50.
12. Kim HY, Im JG, Goo JM et al. Bronchial anthracostenosis (inflammatory bronchial stenosis with anthracotic pigmentation): CT findings. Am J Roentgenol 2000;174:523-7.
13. Barış Yİ, Hoskins JA, Seyfikli Z, Demir A. 'Biomass Lung': Primitive Biomass Combustion and Lung Disease. Indoor Built Environ 2002;11:351-8.
14. Özbay B, Uzun K, Arslan H, Zehir İ. Functional and radiological impairment in women highly exposed to indoor biomass fuels. Respirology. 2001;6:255-8.
15. Smith KR. Fuel combustion, air pollution exposure, and health: The situation in developing countries. Annu. Rev. Energy Environ. 1993;18:529-66.
16. Mireles-Cabodevila E, Karnak D, Shah SS, Mehta AC. Anthracostenosis. J Bronchol 2006;13:153-5.
17. Global tuberculosis control – surveillance, planning, financing. WHO Report 2005 WHO/HTM/TB/2005.349
18. Tahaoğlu K, Kızkın Ö, Karagöz T, Başözdemir N. Endobronchial tuberculosis. Solunum 1994;18:146-53 (In Turkish)
19. Chung HS, Lee JH. Bronchoscopic assessment of the evolution of endobronchial tuberculosis. Chest 2000;117:398-403.
20. Mishra VK, Retherford RD, Smith KR. Biomass cooking fuels and prevalence of tuberculosis in India. Int J Infect Dis 1999;3:119-29.
21. Behera D, Jindal SK, Malhotra. Ventilatory function in nonsmoking rural Indian women using different cooking fuels. Respiration 1994;61:89-92.