

Pneumothorax in the cases with silicosis due to denim sandblasting

Kot taşlamaya bağlı silikozis olgularında pnömotoraks

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Background: This study aims to report secondary spontaneous pneumothorax cases, presenting in acute and accelerated forms of silicosis associated with working in sandblasting jobs.

Methods: The study included seven male patients (mean age 20.4 years; range 17 to 23 years) with secondary spontaneous pneumothorax caused by silicosis, who worked in small workplaces producing sandblasted jeans within the past five years. In all cases, pneumothorax was diagnosed by posteroanterior chest X-ray evaluation.

Results: The mean duration of exposure to silica particles was 34.4 months (range 24-48 months). In the first case, the diagnosis of silicosis was confirmed with an open lung biopsy, whereas in other patients, diagnosis was established by historical, clinical, and radiological evaluations. All of the patients had various degrees of dyspnea and chest pain. Pneumothorax was seen on the right side in three cases and on the left side in two cases, while bilateral pneumothorax was seen in two cases. Tube thoracostomy was performed in all patients, while pleurodesis with tetracycline was performed in two patients. None of the patients developed recurrent pneumothorax.

Conclusion: Our study showed an increased incidence of secondary pneumothorax in acute and accelerated forms of silicosis due to denim sandblasting. Pneumothorax due to silicosis may cause serious morbidity and mortality. The most important steps to cope with silicosis and pneumothorax is to take preventive precautions, as the disease is incurable.

Key words: Denim sandblasting; pneumothorax; silicosis.

Silicosis is an occupational lung disease caused by the inhalation of free silica. Workers in certain occupations are exposed to high concentrations of silica due to its fibrogenicity which causes radiological and pathological abnormalities in the lungs. Although silicosis is a preventable disease, it continues to be an important health problem, especially in low-income communities.^[1] It is well known that certain occupations, such as tunnel

Amaç: Bu çalışmada kot taşlama işine bağlı silikozisin akut ve hızlandırılmış formlarında seyreden sekonder spontan pnömotoraks olguları bildirildi.

Çalışma planı: Çalışmaya son beş yıl içerisinde taşlanmış kot pantolonu üreten küçük işyerlerinde çalışan ve silikozise bağlı sekonder spontan pnömotoraks gelişen yedi erkek hasta (ort. yaş 20.4 yıl; dağılım 17-23 yıl) dahil edildi. Pnömotoraks tanısı tüm olgulara posteroanterior akciğer grafisi değerlendirilmesi ile konuldu.

Bulgular: Silika partiküllerine maruziyet süresi ortalama 34.4 ay (dağılım 24-48 ay) idi. Silikozis tanısı ilk olguda açık akciğer biyopsisi ile doğrulanırken, diğer hastalarda öykü, klinik ve radyolojik değerlendirmeler ile kondu. Hastaların hepsinde çeşitli derecelerde dispne ve göğüs ağrısı vardı. Pnömotoraks üç olguda sağ tarafta, iki olguda sol tarafta yerleşim göstermekte iken, iki olguda da iki taraflı idi. Tüm olgulara tüp torakostomi uygulanırken, iki olguya tetrasiklin ile plöredez uygulandı. Hiçbir hastada pnömotoraks nüksü gelişmedi.

Sonuç: Çalışmamızda kot taşlamaya bağlı silikozisin akut ve hızlandırılmış formlarında sekonder pnömotoraks insidansının arttığı görülmektedir. Silikozise bağlı pnömotoraks ciddi morbidite ve mortaliteye neden olabilir. Silikozisin tedavisinin olmaması nedeniyle hastalığı önlemeye yönelik tedbirler alınması, silikozis ve pnömotoraksla başa çıkmada en önemli adımlardır.

Anahtar sözcükler: Kot taşlama; pnömotoraks; silikozis.

digging, mining and quarrying, have a high risk for silicosis. In recent years, silica exposure has been reported in the textile sector in Turkey as the result of a new and unusual source of silicosis caused by the sandblasting of denim jeans.^[2-4]

Pleural involvement, including pleural effusion, pleural thickening, or pneumothorax, is rarely seen in silicosis. Pneumothorax is one of the most important

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complications of silicosis associated with pleura. It is usually seen unilaterally during the course of chronic silicosis and may sometimes be fatal. However, pneumothorax is uncommon in acute and accelerated forms of silicosis.^[5-7] In this study, we report seven secondary spontaneous pneumothorax cases (two of which were bilateral) in acute and accelerated forms of silicosis caused by the sandblasting of jeans over a 24-48 month period.

PATIENTS AND METHODS

In the Thoracic Surgery Department of the Medical Faculty of Atatürk University between January 2004 and December 2009, a secondary spontaneous pneumothorax was detected in seven male patients (mean age 20.4 years; range 17 to 23 years) with silicosis who had been working in small workplaces manufacturing sandblasted jeans. Researchers retrospectively reviewed all patient records for information, including the following: patient age and gender, symptoms, duration of exposure to silica particles, diagnostic methods, localization of pneumothorax, applied treatment methods, morbidity, mortality, duration of hospitalization, and recurrence of the disease. In all cases, pneumothorax was diagnosed by posteroanterior chest X-ray evaluations.

RESULTS

The mean duration of exposure to silica particles was 34.4 months (range 24-48 months). In the first case, diagnosis of silicosis was confirmed with an open lung biopsy, whereas in other patients, combinations of typical occupational, historical, clinical, and radiological evaluations were used in the diagnosis. All of the patients had various degrees of dyspnea and chest

pain. Five (71.4%) patients had productive coughs, two (28.6%) experienced sweating, and one patient presented with abdominal distension, loss of weight, and malaise. Five (71.4%) patients had a history of smoking.

Chest X-rays of all patients revealed bilateral, widespread, reticulonodular, and nodular appearances. Pneumothorax was located on the right side in three cases, on the left side in two cases, and was bilateral in two cases (Figure 1). A tube thoracostomy was performed on all patients, and two patients underwent pleurodesis with tetracycline. Table 1 summarizes the age, duration of exposure, localization of pneumothorax, and treatment of the cases. The average duration of hospitalization was 10.7 days (range 6-17 days). Sputum examination and cultures for *Mycobacterium tuberculosis* (*M. tuberculosis*) were negative. On follow-up, one of the cases had died six months after being discharged from the hospital. None of the remaining patients showed a recurrence of pneumothorax.

DISCUSSION

In recent years, sandblasting of jeans using silica has emerged as a new cause of silicosis in Turkey. Sandblasting involves spraying sand particles with compressed air or steam onto the cloth to soften, discolor, and abrade the jeans. In Turkey, reported silicosis cases generally involve younger workers whose working conditions are poor with no serious protection for their airways.^[2-4]

Silicosis has three different clinical and pathological forms depending on the contact time with the dust, the intensity of the dust, and the reaction occurring in

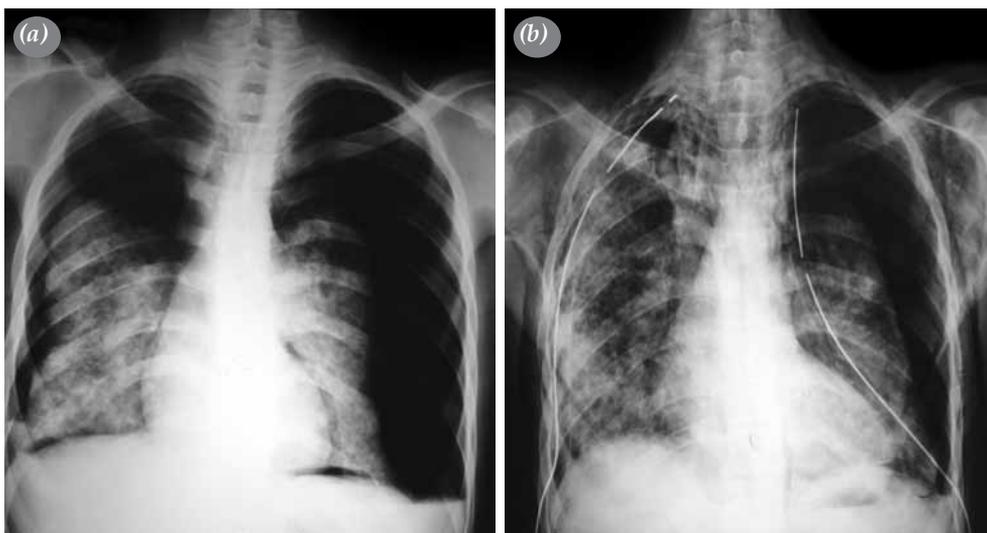


Figure 1. It shows bilateral pneumothorax before (a) and after (b) chest tube insertion.

Table 1. Characteristics of the patients

Case	Age	Exposure time (months)	Localization of pneumothorax	Treatment
1	17	30	Left	Tube thoracostomy
2	19	43	Right	Tube thoracostomy
3	19	24	Bilateral	Tube thoracostomy
4	21	36	Right	Tube thoracostomy plus pleurodesis
5	22	24	Bilateral	Tube thoracostomy plus pleurodesis
6	22	36	Left	Tube thoracostomy
7	23	48	Right	Tube thoracostomy

the lungs against the dust. The acute form emerges in a short period of time after the inhalation of high intensity dust in the air, and the course may be fatal. In the cases presented here, the duration of exposure to silica dust spanned from several months to five years. The mean duration of exposure was 34.4 months, and the clinical courses had a rapid progression. In these patients, silicotic alveolar proteinosis may occasionally develop. Many nodules smaller than 10 mm in diameter are usually evident. The most common types are the chronic or classic form, which are characterized by the inhalation of silica dust for 15 years or more, progressive dyspnea, and radiological features of massive fibrosis. Conglomerated nodules of more than 10 mm in diameter can be seen. The accelerated form is an intermediate type between the acute and chronic forms. Disease emerges after a few years of dust exposure and shows rapid progression. In this form, progression of the disease continues even after dust exposure has been prevented.^[2,5,8]

Generally, a diagnosis of silicosis is not difficult considering the history of exposure to silica dust and characteristic radiological appearances. A lung biopsy is rarely required. In this study, a lung biopsy was used only for the first patient. For all the other patients, the diagnosis of silicosis was established via historical, clinical, and radiological evaluations. Tuberculosis is the most common complication of silicosis, and it has a significant impact on morbidity and mortality. Active tuberculosis should be suspected in silicosis patients, and the presence of a cavity may be a good indication of this disease.^[8]

Tuberculosis may contribute to the development of massive fibrosis in silicosis patients. This condition can be seen in 20-25% of silicosis patients during their lifetimes.^[9] There was no tuberculosis found in this study. Other complications are esophageal compression, and left recurrent laryngeal nerve palsy along with chronic cor pulmonale, pneumothorax, and bronchial tree perforation by calcified lymph nodes.^[9]

It is believed that crystalline silica is most pathogenic when it is smaller than 1 μ m in diameter.^[5] Direct tissue damage by silica particles causes an imbalance between the inflammatory response products. In turn, this has an effect on the elasticity of the alveolar walls, formation of alveolar blebs in the upper lobes, and some congenital defects. Thus, pneumothorax development can be seen with the dysfunction of type 2 alveolar cells.^[7]

Pneumothorax is rarely seen in the course of silicosis, but when it is present, it is usually unilateral. It commonly emerges during chronic silicosis and is accompanied by progressive massive fibrosis. Sporadic spontaneous pneumothorax cases have been reported in accelerated silicosis.^[5] Mohebbi et al.^[10] reported that in acute and accelerated silicosis, there is a significant association between the presence of bulla and secondary spontaneous pneumothorax. In this study, we reported seven pneumothorax cases with acute and accelerated silicosis.

As in other cases of secondary spontaneous pneumothorax, pneumothorax induced by silicosis requires an aggressive approach to treatment. However, there is no accepted consensus for the treatment. In these patients, tube thoracostomy should be applied in all cases, even in the first episodes, due to the presence of excessive pulmonary inflammation and fibrosis and the high tendency for recurrence. Reexpansion of the lung is difficult in silicosis patients. It seems that applying negative pressure to tubes is necessary to reexpand the lungs. More rarely, pleural abrasion via axillary thoracotomy or video-assisted thoracic surgery (VATS) should be performed in silicosis patients with a massive air leak which prevents the lungs from reexpansion. The recurrence rate was reported as 2-14% after VATS, and 0-7% after thoracotomy. The possibility of conversion to thoracotomy due to technical difficulties in patients who underwent an operation with the planned VATS was reported as 29%. In these patients, the presence of severe pulmonary disease increases the surgical risks since VATS requires single lung ventilation. In addition, detachment of the staples due to inflamed

and fibrotic tissue further increases the risk. Standard thoracotomy should be avoided in cases that require open surgical intervention. Axillary thoracotomy is preferable in which a minimal, muscle-sparing incision leads to lesser stretching of the ribs.

Complications rate is approximately 30% and mortality could be up to 50% after surgical treatment of secondary spontaneous pneumothorax.^[11] The authors of this paper do not believe that surgical treatment should be the standard in first-episode patients with silicosis since many patients have respiratory limitation due to underlying pulmonary disease. In most patients, pneumothorax can be treated with only chest tube drainage or pleurodesis. Surgical treatment may increase morbidity and mortality.

Today, silicosis is considered to be an untreatable disease, even though there are treatment options such as lung transplantation for terminal-stage patients and whole lung lavage for removing dust particles, inflammatory cells, and cytokines.^[11,12] The prevention of silica exposure remains the most convenient and effective approach.

In conclusion, this study shows that pneumothorax due to silicosis can cause serious morbidity and mortality. When chest pain and dyspnea occur suddenly in silicosis patients, diagnosis must be made quickly, and pneumothorax should be kept in mind.

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