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Silicosis in Turkish denim sandblasters

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Background Sandblasting of jeans in small Turkish workshops has recently been recognized as a cause of silicosis.

Case series Between August 2004 and March 2006, we admitted 16 young men with a history of working in small workplaces producing sandblasted jeans. Of these, 14 presented with respiratory symptoms and the remaining two through awareness of their work colleagues. In the first two cases, open-lung biopsy was required to confirm the diagnosis of silicosis. Later cases were diagnosed through a combination of their work history and the clinical and radiological findings. The mean age at presentation was 23 years with mean duration of employment as a sandblaster being 3 years. The first two cases died and the remainder, except two, are still receiving treatment.

Conclusion The production of sandblasted jeans in small uncontrolled workplaces may entail significant exposure to silica and the development of rapidly fatal silicosis. Urgent action is required to prevent further cases and mortality.

Key words Denim; sandblasting; silicosis.

Introduction

Silicosis is a well-known occupational disease although new occupational causes of silicosis continue to be reported. We have recently reported two concomitant cases of silicosis in a new occupation, 'denim sandblasting' [1]. Since then, an additional 14 similar cases have been admitted to our hospital. We report this case series and highlight the occupation of denim sandblasting with the aim of trying to prevent further new cases of this preventable condition.

Case series

Between August 2004 and March 2006, 16 male workers producing sandblasted jeans were admitted to our hospital (Ataturk University, School of Medicine, Aziziye Research Hospital, Erzurum, Turkey) for further investigation. Fourteen reported significant respiratory symptoms and a further two cases were investigated at their request as they were aware of the symptoms of their co-workers.

We obtained detailed histories including symptoms, demographic characteristics and workplace exposures. Chest X-ray and high-resolution computerized tomography of the thorax (HRCT) were taken simultaneously. The chest X-ray was obtained at maximal inspiration and was evaluated according to the International Labour Organization (ILO) classification [2,3]. HRCT slices were obtained 1 mm in thickness and at 10-mm scan intervals from the apex of the lung to the base of the diaphragm. The ILO reading and HRCT interpretation were performed by an experienced ILO reader and an experienced radiologist, respectively.

In the diagnosis of the first two cases to present, an open-lung biopsy specimen had been required, because of the atypical characteristics of the cases and lack of any previous report of silicosis in this occupation. We therefore established a diagnosis of silicosis caused by sandblasting jeans through histopathological examination (Figure 1a,b) in the first two cases to present in 2004 [1]. In Case 8, the diagnosis had also been confirmed after open-lung biopsy in another centre approximately a month before his admission. A further four similar cases presented to our hospital in 2005 and another 10 in 2006. In these cases, the diagnosis was established through a combination of their work history and the clinical and radiological findings. Although Cases 9 and 14 were admitted without apparent symptoms, they were aware of the illness of their co-workers and were also shown to be affected functionally and radiologically. The actual working conditions could not be evaluated as the workplaces were located in another city (Istanbul, Turkey). However,

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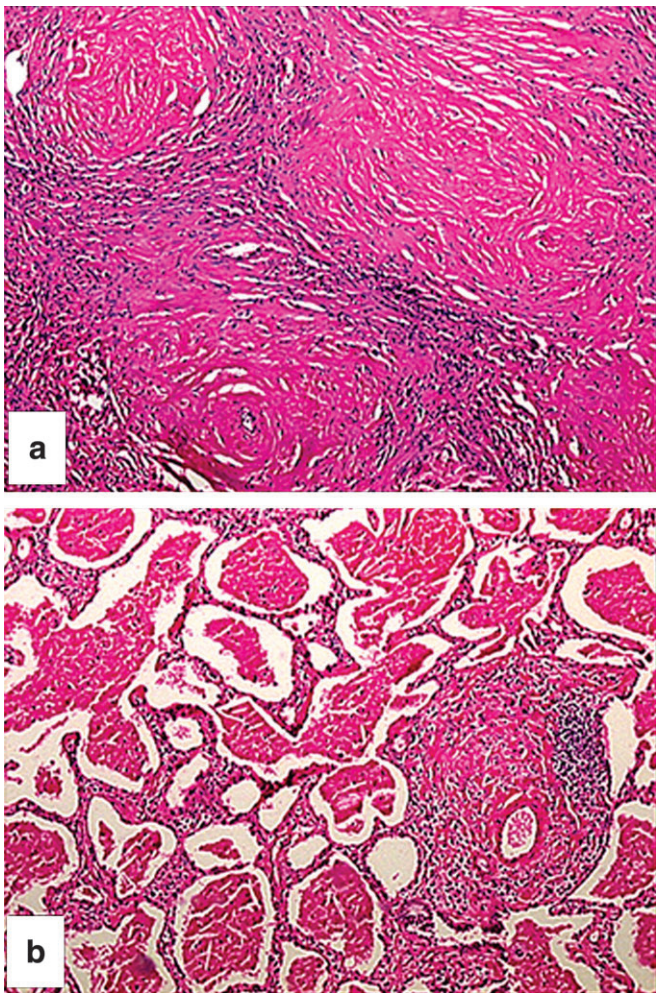

Figure 1. Two examples of open-lung biopsy specimens taken from first two cases show silicotic nodules (a) and the adjacent alveoli filled with lipoproteinaceous materials (b).

we were aware from obtained photographs and descriptions of the workplace that exposures were likely to be very high and that protective measures or personal protective equipment was not generally available. Written informed consent, in Turkish, of the cases was obtained regarding the publication of their data.

The characteristics of the cases including age, admission times and detailed exposure properties are summarized in Table 1. Mean age was 23 ± 6 years (range 17–43). They all had a history of working in small workplaces sandblasting jeans but none of them were currently working on admission. Their primary work was to abrade jeans using silica. Their mean first exposure age was 17 ± 6 years (range 13–37), the mean duration of employment was 3.0 ± 2.2 years (range 0.5–10) or 36.6 ± 26.0 months (range 6–120), the mean weekly duration of working time was 6.0 ± 0.5 day/week (range 5–7), the mean daily duration of working time was 9.75 ± 8.24 h/day (range 6–12) and the mean cumulative exposure time was 9752 ± 8236 h (range 780–37 440).

Cases 1 and 3 had previously been misdiagnosed as tuberculosis in other centres. The most common respiratory complaints were dyspnoea and cough. Physiological and/or radiological abnormalities were detected in all cases including asymptomatic ones (Table 2).

The spirometric findings and the ILO classification are summarized in Table 2. Examples of chest X-rays belonging to Cases 5, 7, 8 and 12 and HRCT imaging belonging to Case 8 are given in Figures 2a–d and 3, respectively.

The symptomatic cases were treated with systemic steroids in combination with tuberculosis prophylaxis, bronchodilators and oxygen as necessary. The first two cases had more severe disease and died due to respiratory insufficiency 4 and 9 months later,

Table 1. Admission and exposure characteristics of the cases

Case number	Admitted	Age on admission	First exposure age	Employment time (months)	Weekly working days	Daily working time (h)	Cumulative exposure (h)
1	August 2004	19	14	43	6	11	12 298
2	September 2004	18	13	44	6	11	12 584
3	July 2005	25	16	24	6	10	6240
4	August 2005	25	24	6	5	6	780
5	October 2005	17	15	30	6	10	7800
6	November 2005	23	15	36	7	11	12 012
7	January 2006	21	17	36	5	8	6240
8	February 2006	22	14	48	6	6	7488
9	February 2006	22	18	24	7	10	7280
10	February 2006	20	14	48	6	10	12 480
11	February 2006	18	13	48	6	10	12 480
12	February 2006	43	37	30	6	10	7800
13	February 2006	19	15	24	6	10	6240
14	February 2006	27	18	12	6	11	3432
15	February 2006	26	18	12	6	11	3432
16	March 2006	24	14	120	6	12	37 440

Table 2. Clinical findings, pulmonary function tests and radiological characteristics of the cases on admission

Case number	Symptoms (duration)	Smoking (pack-year)	Spirometry findings[a] (as % predicted)			Chest X-ray findings according to ILO classification[b]	
			FVC	FEV_1	FEV_1/FVC	Size	Profusion
1	Malaise, dry cough, sweating, loss of weight (3 months)	3	–	–	–	q/r	3/+
2	Dyspnoea (4 years)	–	53	69	96	q/q	3/2
3	Dyspnoea, productive cough, malaise (1 year)	–	72	76	93	q/r	2/3
4	Indefinite whole-body pain (7 months)	4	88	94	91	q/r	1/2
5	Dry cough, chest pain (1.5 years)	–	61	61	93	q/r	3/+
6	Dyspnoea (6 months)	7	86	81	80	q/q	1/2
7	Dyspnoea, cough, chest pain, malaise (1 year)	15	80	75	80	r/q	3/3
8	Dyspnoea, chest pain, cyanosis (4 months)	4	39	41	89	q/t	2/1
9	No symptom	5	80	91	116		
10	Chest tightness, abdominal distension (2 years)	4	104	98	81	p/q	0/1
11	Productive cough, chest pain (1 month)	3	102	99	83		
12	Dyspnoea, abdominal distension (11 months)	12	92	83	74	q/r	3/2
13	Dyspnoea (1 year)	–	82	52	54	q/q	3/3
14	No symptom	4	114	106	78	q/q	1/1
15	Productive cough (6 years)	14	92	77	73	q/r	2/3
16	Dyspnoea, back pain (2 years)	–	70	66	75	q/q	1/2

FVC, forced vital capacity; FEV1, forced expiratory volume in 1 s; p, round opacities up to 1.5 mm in diameter; q, round opacities 1.5–3 mm in diameter; r, round opacities 3–10 mm in diameter; t, moderately coarse irregular opacities.

[a]In Case 1, spirometry was not performed due to suspicion of tuberculosis on his admission.

[b]Chest X-rays of Cases 9 and 11 were not available for ILO reading. Cases 1, 7 and 12 had large opacities.

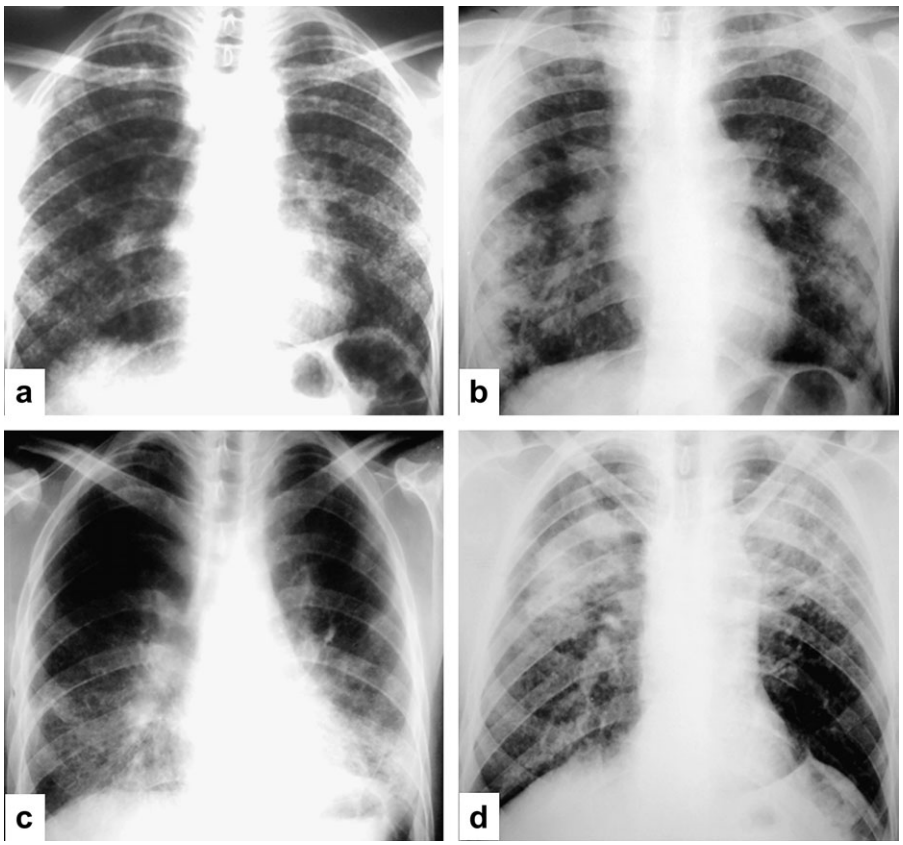

Figure 2. Chest X-ray imagings of Case 5 (a), 7 (b), 8 (c) and 12 (d), in which there are more prominent findings than others, show bilateral interstitial infiltrates, which are prominent in the lower zones (a), large opacities located predominantly peripheral (b) and in the upper zones (d) and fibrotic changes in the lower lobes (c).

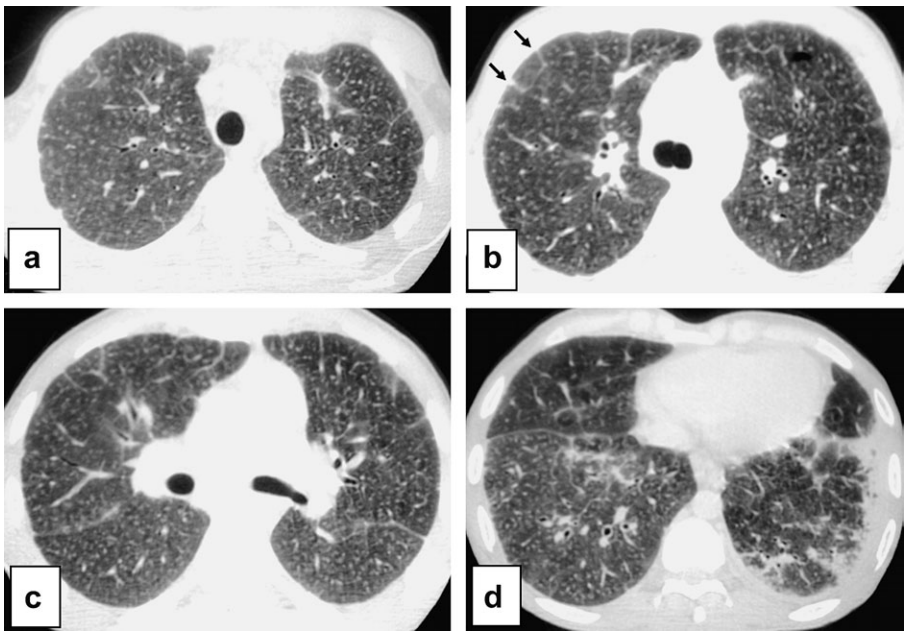

Figure 3. HRCT imaging of Case 8 shows centrilobular nodules throughout entire lungs (a, b, c and d), interlobular septal thickening (b, black arrows) and fibrotic changes in the left lower zone (d).

respectively, after confirmation of the diagnosis. Follow-up of the other cases is still continuing.

Discussion

The case series we present here is alarming in that it demonstrates that silicosis, a long-recognized but preventable occupational disease can still occur in previously unrecognized occupations. The occupation of sandblasting denim jeans is relatively new and has developed as a result of changes in fashion in developed countries and the demand for worn-looking jeans. Tragically, this condition has occurred in very young men with an average of only 3 years in this particular occupation. Lack of awareness of the condition and the dangers of silica and inadequate protective measures have already had fatal results. Silicosis is a well-known disease and its clinical forms have been well characterized. The classical form of silicosis usually follows one or more decades of exposure. However, in contrast to the chronic or classical form of silicosis, the accelerated and acute forms result from intense exposure to high levels of respirable dust that contain a significant proportion of silica, and these develop after much shorter duration [4]. In our cases, there was a heavy exposure history to silica due to closed, poorly ventilated work areas, long daily working hours and no effective protection. Because the workplaces were located in another city (Istanbul, Turkey), we have not been able to visit and assess these workplaces in more detail but photographs that we have been shown confirm extremely poor working conditions with no evidence of any protective measures. We also know that there are many other workplaces (Figure 4) where sandblasting takes place for different reasons [5], and with similar poor conditions, and other cases of silicosis have been reported [6] although these cases were older than ours and their exposure histories were longer. Because of the increased popularity of sandblasted jeans, it is highly possible that the incidence of such cases will continue to increase in the future. Although sandblasting with sand containing free silica is

Figure 4. A view of a small-scale sandblasting workplace (reproduced from [5], with kind permission from the *Journal of Occupational Health* and the first author, Dr Can Sevinc).

restricted in some European countries [7], it seems that it is widely used in different workplaces, especially in the smaller ones, in Turkey since it can be obtained easily and cheaply [5]. Although employing young workers is banned in Turkey as in many developed countries, most smaller workplaces are unregulated. The combination of unregulated small workplaces, employment of younger workers, lack of awareness and protective measures is likely to result in more severe clinical manifestations and death than classical cases of silicosis and requires urgent measures to prevent further cases and mortality.

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Conflicts of interest

None declared.

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