THE CORRELATION BETWEEN SILICOSIS AND LUNG CANCER —PATHOLOGICAL EVIDENCES FROM 5 AUTOPSIED CASES

YU TONG

The Occupational Diseases Hospital, Second Railway-Engineering Bureau
Ministry of Railways of China, Sichuan Chengdu

Recent epidemiologic studies suggested a high risk of lung cancer among workers exposed to silica dust. The Occupational Hospital, an organization to cure workers with silicosis caused by railway-tunnel-building, also found that among these patients the risk of dying from lung cancer was greater than compairson population. This paper reported certain pathological correlation between silicosis and lung cancer based on pathological materials.

ILLUSTRATIVE CASES

Case 1: 53 year-old man, tunnel-building for 9 years, with massive silicotic fibrotic lesions in both upper lobes of lungs. In the subpleural of both base parts of lungs, was found numerous greyish-white nodules, about the size of peas (Figure 1). Microscopically, the bronchiolar epithelium showed obvious hyperplasis, the dialated bronchiolar lumens were full of hyperplastic epithelium. A few of these bronchioles showed anaplastic change and began to invade into surrounding tissues, presenting an early appearance of adenocarcinoma (Figures 2, 3).

Case 2: 58 year-old man, tunnel-building for 34 years, with history of smoking. There is a massive silicotic fibrotic lesion associated with tuberculosis in right upper lobe. The bronchogenic carcinoma also developed in the same lobe (Figure 4). Why did the cancer of bronchus develop in the same lobe? The bronchus near the massive silicotic lesion showed deformation and their epithelium often being destroyed, andd proliferation metaplasia anaplasia ensued, finally squamous cancer developed (Figures 5, 6).

Case 3: 58 year-old man, tunnel-building for 8 years, with history of smoking. In addition to the generally distributed silicotic nodules throughout the whole lungs, the nodules in the left upper lobe showed tendency to coalesce. In the site where the superior and inferior bronchi bifurcated, there was a large silicotic enlarged lymph node 2.3 cm in diameter which oppressed on the superior and inferior bronchi, the cancer developed right there (Figure 7). Microscopically, showed low-differentiated large cell cancer (Figures 8, 9).

Case 4: 60 year-old man, railway-building for 38 years, with history of smoking. In both upper, middle and lower lobes scattered with silicotic nodules. In the middle lobe of the right lung (near the hilar), there was a massive silicotic fibrotic lesion (5×2 cm). In the right hilar region, a bronchogenic large tumor surrounded the bronchuss and obstructed its lumen (Figure 10). Microscopically, that was a low-differentiated small cell cancer (Figures 11, 12).

Case 5: 58 year-old man, tunnel-building for 6 years, with history of smoking. All lobes of both lungs scattered with silicotic nodules. In the upper lobe of left lung there was a (5×4.5×4.5 cm in size) black and white interlacing region.

Figure 1. (Case 1): In the subpleural silicotic collagenous region of base part of right lung was found numerous greyish-white nodules. (forked tail arrowed).

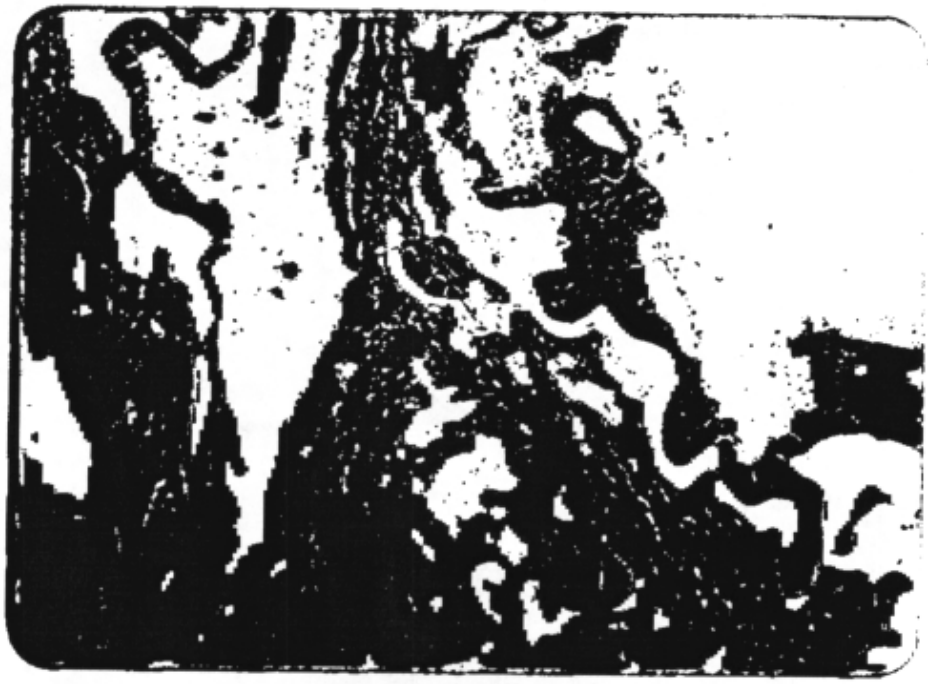

Figure 2. (Case 1): A few of greyish-white nodules present an early appearance of adenocarcinoma (H&E, ×50).

Figure 3. (Case 1): Higher power view of cancer shown in Figure 2 showing poorly differentiated tumour cells (H&E, ×200).

Figure 4. (Case 2): Bronchogenic cancer developed in the same lobe that the massive silicotic lesion existed. (Forked tail arrowed the silicotic lesion; the others arrowed the the cancer and tuberculosis area.)

In that region there was a silicotic fibrotic coalescing lesion in the size of 2×1.5 cm (Figure 13). Microscopically, the white region was cancer. Histologically, it was bronchiole-alveolar cancer (Figure 14). This case associated with tuberculosis too (Figure 15).

DISCUSSION

From the pathological viewpoint, in those 5 cases of silicosis associated with lung cancer, the development of cancer all have some correlation with the preexisting silicosis. In two of those five cases (Cases 2, 5), the cancer developed on the same lobe the massive silicotic lesion existed. In one case (Case 4) the cancer developed in the right hilar bronchus close to the massive silicotic fibrotic lesion. In one case (Case 3) the cancer developed on the site where the left bronchus bifurcated into superior and inferior bronchi oppressed by the silicotic enlarged lymph node. In another case (Case 1) the cancer developed from multiple deformed bronchioles which remained in the subpleural silicotic collagenous region.

Emmanuel Farber[1] put forward that "Dependence on cell proliferation for initiation" of carcinogenesis and "In fact, we think that the rate- limiting step in some types of cancer development, such as in the liver, the urinary bladder, and the pancreas, to name but three, may not be the exposure to a carcinogen but rather the presence or absence of concomitant cell or tissue damege." At silicosis it can be seen that varied silicotic lesions of the lung often caused deformation stenosis of the bronchus and the mucomembrane of bronchus often continuously damaged. It created an important favourable factor for the development of lung cancer. It is well known to us that Stenbeck et al.[1] intratracheally instilled SiO_2 or Hap or SiO_2 together with Hap to the syrian golden hamsters, the lung cancer incidence of the latter group was 4 folds more than the Hap group. Holland et al.[1] made an experiment that Fischer-344 ratsss were exposed to silica (Mun-U-Sil) 6 hours per day, 4 days a week for 24 months at an airborne concentration of 12 mg/m^3. It produced a respiratory epithelium tumor incidence of 27%. Hesterberg et al.[3] cultivated hamster's embryo cells with Min-U-Sil (a high SiO_2 content) showed tumor transmutation.

Holland[1] suggested that in his animal experiment the carcinogenesis of the silica were due to lung scaring produced by silicotic lesion in rats, but in our st u dy only one case (Case 1) belongs to the scar cancer. Saffiotti[3] suggested that the target cell of the silica carcinogenesis is bronchiole-alveolar cell but in our study only one case (Case 5) is bronchiole-alveolar cancer. All others (Cases 2, 3, 4) the cancer developed on the basis of repeat bronchus and their mucomembrane damage caused by the silicotic lesions. The development of those bronchogenic lung cancers corresponded more or less with the pattern of Farber and animal experiment of Stenback.

REFERENCES

1. David, F. et al.: Does occupational exposure to silica cause lung cancer? *Am. J. of Industrial Medicine*, 3:423-435, 1982.
2. Farber, E.: Chemical, Evolution, and Cancer Development. Rous-Whipple Award Lecture. *Am. J. Pathol.* 108:270-275, 1982.
3. Saffiotti, U.: Silica Silicosis and Cancer, p. 287, Praeger Publishers, New York, 1986.

ACKNOWLEDGEMENTS: I would like to thank: the director of occupational hospital, Dr. Li-chunfang for his support in this work; Dr. Zhang-jisheng for grammatical consultation; Dr. Peng-hongquan for passing me the information that the VIIth IPC would be held on August 23-26, 1988; Comrade Tao-xiaohua for typing thiss manuscript; Comrade Yang-dongke for photography.

Figure 5. (Case 2): The squamous carcinoma developed on the bronchus near the massive fibrotic lesion (H&E, ×50).

Figure 6. (Case 2): The massive silicotic lesion associated with tuberculosis in the same lobe. The alveolar filled with macrophages and Langhan's giant cells and lymphocytes (H&E, ×100).

Figure 7. (Case 3: In the site where the left bronchus bifurcated, there was a large silicotic enlarged lymph node (forked tail arrowed, the white spot is a metastatic focus), which oppressed on the bronchi, the cancer developed right there (single tail arrowed).

Figure 8. (Case 3): Microscopically, this cancer shown in Figure 7 shows an appearance of low-differentiated large cell cancer (H&E, ×100).

Figure 9. (Case 3): The malignant cancer cells spread via perivenous channels (H&E, ×200).

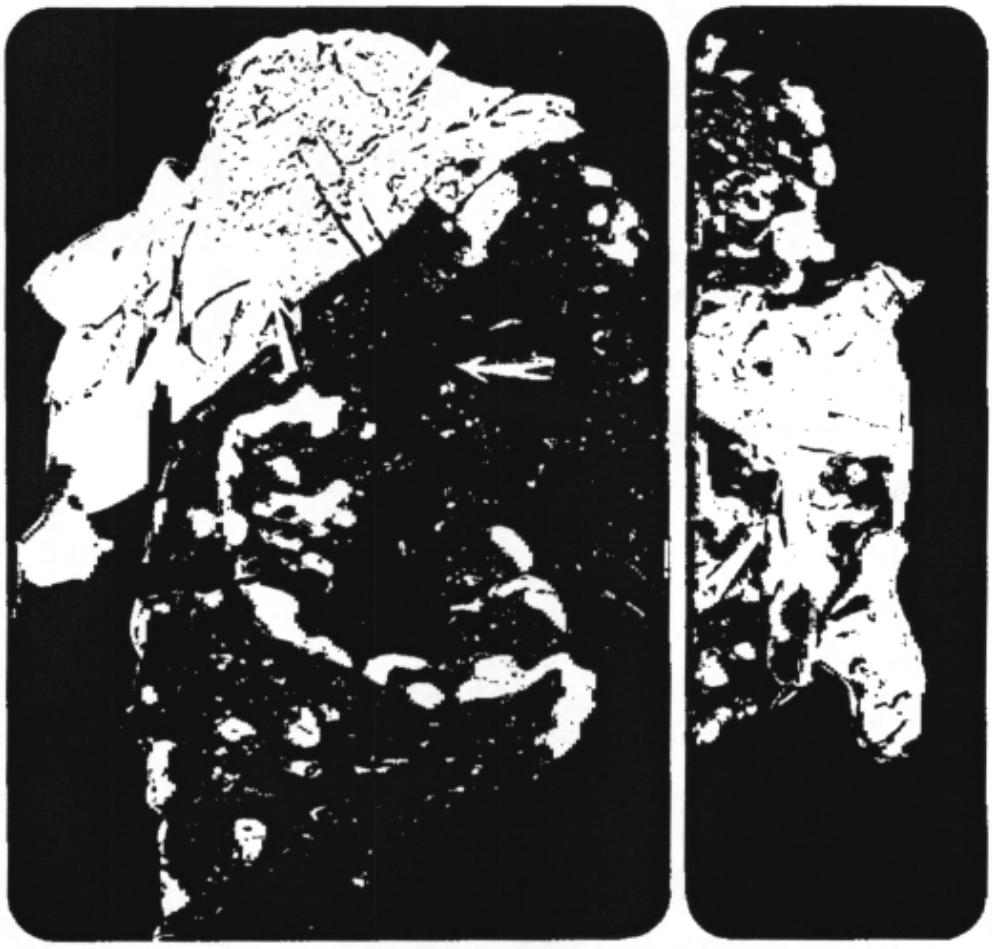

Figure 10. (Case 4): The massive silicotic lesion near the right hilar (forked tail arrowed) and in the hilar region a bronchogenic large tumor developed (single tail arrow). The right photo shows the bronchogenic cancer obstructed the bronchial lumen.

Figure 11. (Case 4): Microscopically, this cancer was a low-differentiated small cell cancer (H&E, ×50).

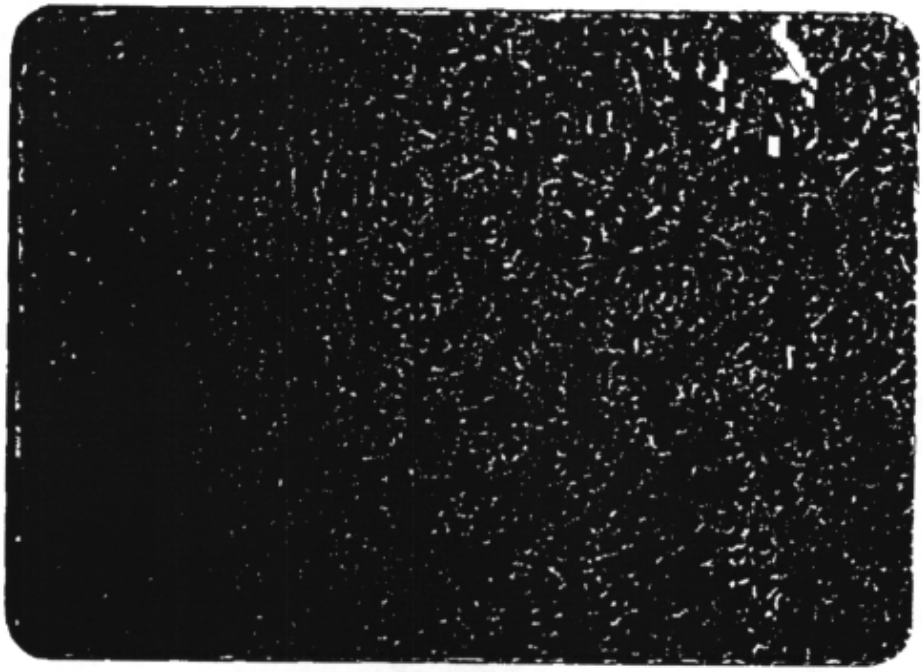

Figure 12. (Case 4): Metastic cancer in the liver shows an appearance of adenocarcinoma (H&E, ×100).

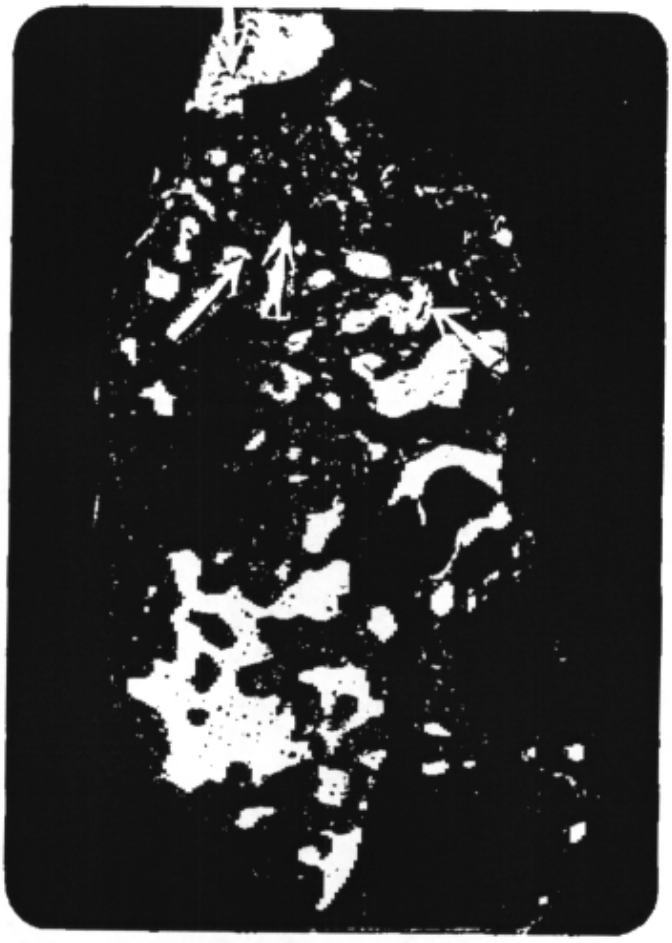

Figure 13. (Case 5): In the upper lobe of left lung there was a silicotic fibrotic lesion in the size 2×1.5 cm (forket tail arrow) surrounded with cancer (single tail arrowed area).

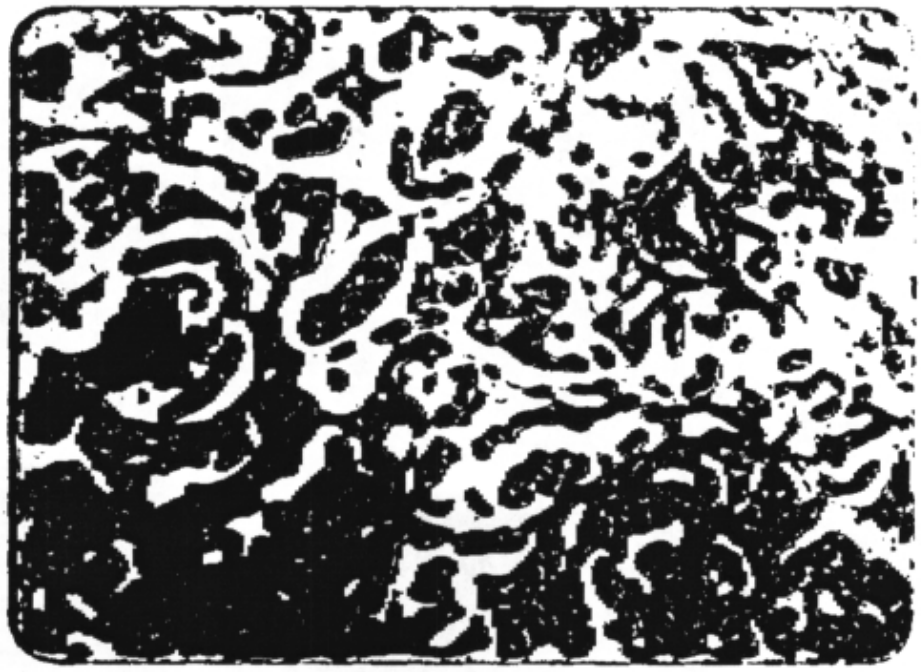

Figure 14. (Case 5): Microscopically, this cancer was a bronchiole-alveolar cell cancer (H&E, ×100).

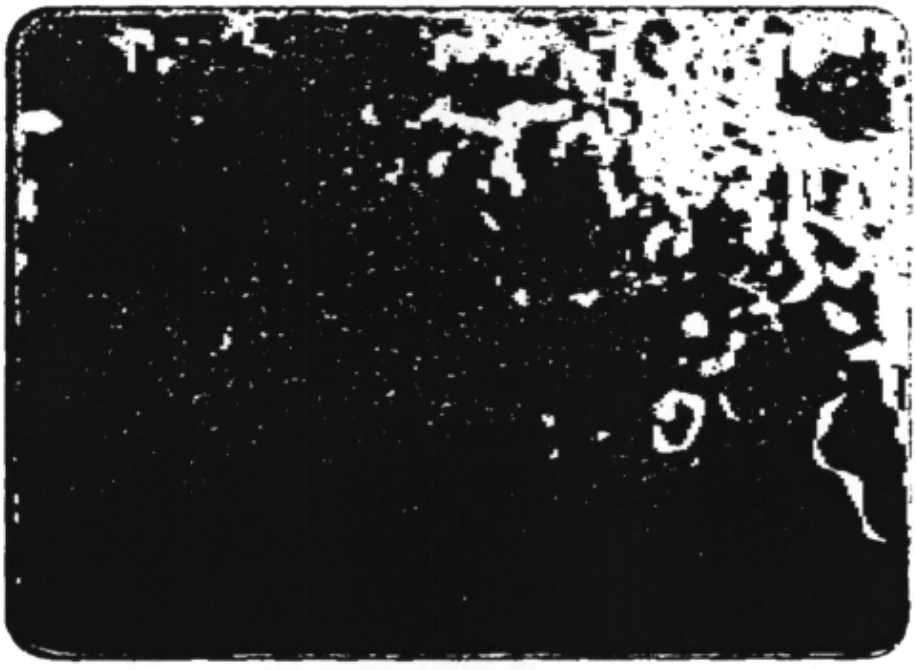

Figure 15. (Case 5): This case associated with tuberculosis too. Note the tubercles with caseation (H&E, ×50).