

Pulmonary Tuberculous Scar as a Factor Affecting Detection of Lung Cancer

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To evaluate the radiologic influence of tuberculous scar on the detection of lung cancer, the results of radiologic screening were retrospectively analyzed. A total of 308,565 persons above 40 years old underwent the screening from 1986 to 1988. For screening, 100-mm indirect chest radiographs were interpreted by two physicians, and compared to findings on one-year old films if necessary. The screening detected 175 peripheral lung cancers and 25,238 tuberculous scars. Both diseases were prevalent in the elderly. Twenty-seven of 175 lung cancers coexisted with tuberculous scar. The high incidence of tuberculous scar in the elderly caused the seeming increase in the incidence of coexistence of lung cancer. In 14 of 21 coexistent cases reviewed, lung cancer was identified retrospectively on one-year old radiographs. In six patients, lung cancer was misinterpreted as a part of tuberculous scar, despite comparison to one-year old films. The present study suggests that radiographs showing tuberculous scar should be carefully compared to previous films taken at least two years earlier.

Introduction

Lung cancer is one of the common malignant neoplasms in the world, and the prevalence is still increasing. In East Asia, the proportion of peripheral lung cancer, especially adenocarcinoma, is high.^{1,2)} The incidence of adenocarcinoma in the United States has also tended to increase, and a similar trend is found in Europe.^{3,4)} The strategy for treating peripheral lung cancer includes increasing radiologic detectability.

Lung cancer is prevalent among the elderly,⁵⁾ who had a high risk of tuberculosis in the past. The prevalence rate of previous tuberculous infection among persons 70-years-old is estimated at 49% in the Netherlands and 75% in Japan.^{6,7)} Despite the decreasing incidence of tuberculosis, various radiological findings of tuberculous scars remain in the lung fields of elderly patients. The prevalence rate of healed tuberculosis is estimated at 18% among Japanese above 70 years old.⁸⁾ Although these findings are thought to affect the radiologic detectability of peripheral lung cancer, few studies have clarified this problem.⁹⁾ This study was carried out to clarify whether the coexistence of

tuberculous scar decreased the radiologic detectability of peripheral lung cancer.

Subjects and Methods

In Nagasaki prefecture, the Nagasaki General Health Center has conducted annual radiologic mass screening for lung cancer since 1985. The target population was all residents above 40 years old, regardless of gender or smoking habits. A total of 308,565 persons, who corresponded to approximately 34% of the target population, underwent the screening from 1986 to 1988. A 100-mm indirect chest radiograph in the postero-anterior view was taken with a mirror camera, and two pulmonary physicians interpreted the films using a magnifying glass. This has been the standard mass screening method in Japan, and is almost equivalent to full-sized direct radiography for detection of lung cancer.¹⁰⁾ When any abnormalities including scars were found, they were compared to findings on one-year old films. Patients with suspected cancer were referred to hospitals for further diagnostic examinations.

Lung cancer was confirmed histologically, and classified according to the World Health Organization histologic type and the International Union Against Cancer staging system.^{11,12)} For staging, computed tomography, bone scintigraphy, and echography were performed in all cases. Peripheral lung cancer was defined as lung cancer except central types of squamous cell carcinoma and small cell carcinoma. Tuberculous scar was defined as fibrotic scarring after the healing of tuberculosis in the lung fields of chest films. Detected lung cancers were divided into two groups, those with and without coexisting tuberculous scar.

The numbers and age distribution of patients with lung cancer were examined, comparing those with and without tuberculous scar. The crude incidence rate of lung cancer among participants with tuberculous scar was estimated as follows: (number of lung cancer with tuberculous scar) / (number of tuberculous scar). The crude incidence rate of lung cancer among participants without tuberculous scar was estimated as follows: (number of lung

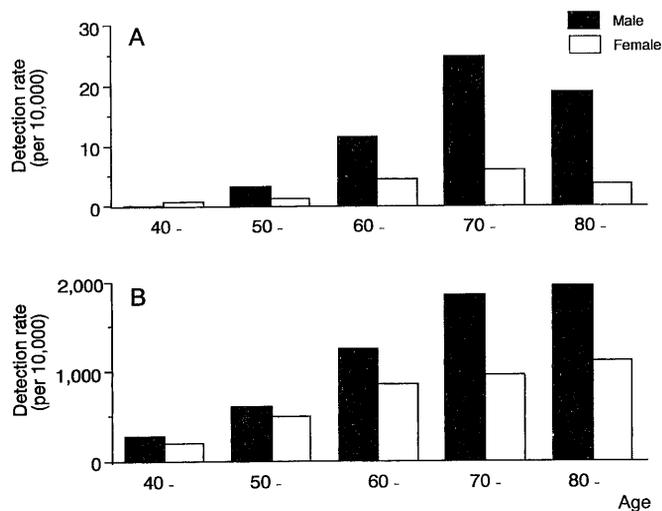


Fig. 1. The age-specific detection rates of lung cancer (A) and tuberculous scar (B)

cancer without tuberculous scar) / (number of all participants - number of tuberculous scar). The incidence rates were age-adjusted according to the age distribution of the 1985 standard Nagasaki population above 40 years old. In patients with lung cancer, chest radiographs taken one year earlier were reviewed to compare to the present films. The results were evaluated by chi-square test and Wilcoxon rank-sum test, and a two-tailed $P < 0.05$ was considered to be significant.

Results

Table 1 shows the numbers and the detection rates per 10,000 of lung cancer and tuberculous scar among 308,565 participants. Both lesions were seen more frequently in male than in female ($P < 0.0001$), and the incidence of tuberculous scar among both genders was more frequent than lung cancer ($P < 0.0001$).

The age-specific detection rates of lung cancer and tuberculous scar per 10,000 patients are shown in Fig. 1. The trends in the rates of the two diseases were similar between male and female. The rate of lung cancer increased until age 80, and its peak in male was 24.9 per 10,000. The rate of tuberculous scar increased with age, and its peak in male was 1,957 per 10,000 at 80 years or older.

The characteristics of 175 lung cancers are summarized in Table 2, comparing the cases of lung cancer with and without tuberculous scar. Twenty-seven (15%) cases who had both lung cancer and tuberculous scar were older than those who had no tuberculous scar ($P < 0.05$). Although the crude incidence rate of lung cancer with scar was higher than that without scar ($P < 0.0001$), there was no significant difference in age-adjusted incidence rate between two groups.

Table 1. The numbers and the detection rates (per 10,000) of lung cancer and tuberculous scar in radiologic screening from 1986 to 1988

Diagnosis	No. (Rate)		
	Male	Female	Overall
Lung cancer	118 (10.4)*	57 (2.9)	175 (5.7)
Tuberculous scar	12,217 (1076)*,+	13,021 (668)+	25,238 (818)-

* $P < 0.0001$ compared to female by chi-square test.

+ $P < 0.0001$ compared to lung cancer by chi-square test.

Table 2. Characteristics of 175 lung cancers with/without coexisting tuberculous scar

	Lung cancer with scar (n = 27)	Lung cancer without scar (n = 148)
Male : Female	22 : 5	97 : 51
Age*(years)	74 : [66, 79] [§]	69 : [64, 75]
Histologic diagnosis		
Adenocarcinoma	16 (59%)	108 (73%)
Squamous cell carcinoma	7 (26%)	32 (22%)
Others	4 (15%)	8 (5%)
Estimated incidence rate of lung cancer ⁺ (per 10,000)		
Crude	10.7	5.2
Age-adjusted [*]	5.9	4.5

* Age was expressed as median : [25%, 75%].

+ Estimated incidence rate of lung cancer among those with tuberculous scar was calculated as (number of lung cancer with tuberculous scar)/(number of tuberculous scar).

≠ Adjusted to the age distribution of the 1985 standard Nagasaki population above 40 years old.

§ $P < 0.05$ compared to lung cancer without scar by Wilcoxon rank-sum test.

|| $P < 0.001$ compared to lung cancer without scar by chi-square test.

Table 3 shows the clinical or pathological stages of 175 lung cancers and retrospective analysis for cancer on previous chest films. Twenty-one (78%) of 27 patients with scars and 106 (72%) of 148 patients without scars underwent serial screenings, and previous radiographs were reviewed. Retrospective analysis using previous chest films showed that distinct shadows of cancer in the patients with scars were more frequently found than those without scars ($P < 0.05$), although there was no significant difference in stages between the two groups.

In six (43%) of 14 patients with scars who had distinct shadow of cancer on previous films, the lung cancer itself had been misinterpreted as a part of the tuberculous scar, because the radiologic findings of lung cancer showed no or

Table 3. Stage and retrospective radiologic evidence of lung cancer according to the coexisting tuberculous scar

	Lung cancer with scar	Lung cancer without scar
	No. (%)	No. (%)
Stage		
I	14 (52)	77 (52)
II-IV	12 (44)	68 (46)
Unknown	1 (4)	3 (2)
Total	27 (100)	148 (100)
Retrospective analysis of cancer		
Distinct	14 (67)*	42 (40)
Faint or absent	7 (33)	64 (60)
Total reviewed	21 (100)	106 (100)

* $P < 0.05$ compared to lung cancer without scar by chi-square test.

minimal changes during one-year intervals. In five (36 %) cases, lung cancer was not recognized at that time. The attention of interpreters was concentrated on tuberculous scar, and lung cancer was obscured by superimposed normal chest structures. Two patients did not undergo further examinations, and one patient was misdiagnosed as having healed lesion during further examinations.

On the other hand, in 27 (64 %) of 42 patients without scars who had distinct shadow of cancer in previous films, lung cancer was overlooked due to superimposed normal structures. In 10 patients (24 %), lung cancer was misdiagnosed as other diseases such as postinflammatory change. The remaining five patients did not undergo further examinations.

Discussion

It is quite difficult to detect peripheral lung cancer at its first radiologic presentation. Most of the peripheral lung cancers were retrospectively shown to have been present on previous radiographs.^{10,13,14} In 51 (65 %) of 78 peripheral lung cancers at Memorial Sloan-Kettering Cancer Center, lung cancers were retrospectively identified on the radiographs taken one year earlier.¹³ Flehinger *et al.* estimated that a single radiologic screening procedure could detect less than 16 % of Stage I adenocarcinoma and large cell carcinoma.¹⁵

Among the sources of perceptual errors, superimposed normal structures or coexisting pulmonary diseases often obscure the nodule, diverting the attention of interpreters away from it.^{16,18} The incidences of tuberculous scar and lung cancer in the elderly were high,^{5,8} and both diseases are known to predominantly involve the apical lung

fields.^{18,19} Although the coexistence of both diseases is considered coincidental at present,^{20,21} the high incidence of tuberculous scar in the elderly causes the seeming increase in the incidence of coexistence of lung cancer. Tuberculous scar is a radiologic problem in evaluation of a pulmonary nodule.⁹

There was no significant difference in clinical stage between lung cancers with and without coexisting scar in this study. Lung cancer, however, was misinterpreted or overlooked more often in patients with tuberculous scar, despite reviewing one-year old films. In general, only 65-70 % of resected stage I patients survive more than five years.^{22,23} It is more important to detect earlier phase in stage I disease, namely stage I disease without distinct shadow of cancer on previous films.

Lung cancers are less conspicuous in a distorted background of tuberculous scar. In this study, coexisting scar diverts the attention of interpreters away from lung cancer, and superimposed chest structures obscured lung cancer. In upper lung fields which lung cancer and tuberculous scar predominantly involve, the crisscrossing of ribs and clavicles not only obscure but also simulate a nodule. These opacities confuse the decision of interpreters.¹⁷ To avoid overlooking, careful reading of overlapping bones and reviewing prior films for comparison are needed.

It is sometimes difficult to distinguish peripheral lung cancer from non-calcified tuberculous scar radiologically. Peripheral lung cancer grows slowly and radiologic findings often show no or minimal changes during one-year intervals.^{24,25} In addition, tuberculoma sometimes shows radiologic findings suggesting malignancy such as spiculation, pleural retraction, vascular convergence, and lobulation.^{26,27} In patients with coexisting scar, lung cancer was often misinterpreted as a part of scar due to the slow growth of lung cancer. A nodule that does not grow over a two-year period is probably benign.^{28,29} When there is coexisting tuberculous scar, a single chest radiograph is not sufficient to definitely exclude lung cancer, and radiographs taken at least two years earlier should be carefully reviewed.

In conclusion, the high incidence of tuberculous scar in the elderly causes the seeming increase in the incidence of coexistence of lung cancer, and the detection of lung cancer in chest radiographs tends to be delayed. The present study suggests that radiographs showing tuberculous scar should be carefully compared with previous films taken at least two years earlier.

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