Spiculation of Lung Mass on CT: Carcinoma vs. Tuberculoma

Tae Il Han, M.D., Dong Wook Sung, M.D., Seung Jae Lim, M.D., Yup Yoon, M.D.

Purpose: Spiculation pathologically correlated with irregular fibrosis, localized lymphatic spread of tumor, or an infiltrative growth pattern of tumor, and the spiculation was observed in malignant mass. But the spiculation was also observed in benign mass, particularly in tuberculoma. We retrospectively reviewed the length of spiculation under the hypothesis that the length of spiculation could be one of differential diagnostic points between lung cancer and tuberculoma.

Materials and Methods: We studied thirty seven patients (27 men and 10 women) ranging in age from 35 to 80 years (mean, 60 years). Analysis of spiculation included (a) the number of spicules (b) the mean length of spicules (c) the mean length of the longest spicule (d) the percentage of the mean length of spicules to the longest diameter of mass (e) the percentage of the mean length of spicules to the shortest diameter of mass.

Results: The mean length of spicules of tuberculoma was 13.8 mm (S. D. 6.7) and that of lung cancer was 5.7 mm (S. D. 3.5). The percentage of the mean length of spicules to the longest diameter of tuberculoma was 63.6% and that of lung cancer was 13.7%. The percentage of the mean length of spicules to the shortest diameter of tuberculoma was 90.4% and that of lung cancer was 18.3%.

Conclusion: It is hard to differentiate lung cancer from tuberculoma on the basis of the spiculation being present or not, but we suggest that the longer spiculation be more highly suggestive of tuberculoma rather than lung cancer. The length of spiculation may help us differentiate lung cancer from tuberculoma.

Index Words: Lung, CT, Tuberculosis, pulmonary, Lung, Neoplasm

INTRODUCTION

In spite of many investigations for the CT appearance of lung-tumor interface and the internal texture of tumor, there still remains a significant difficulty in differentiating malignant lesions from benign lesions. Among the parameters for differentiating malignant lesions from benign lesions, spiculation is known to be pathologically correlated with irregular fibrosis, localized lymphatic spread of tumor, or infiltrative growth pattern of tumor, and it is a finding often observed in a malignant mass (1). However the spiculation is also observed in benign mass such as tuberculoma and it is hard to differentiate lung cancer from tuberculoma on the basis of the spiculation being present or not.

The purpose of the this study is to differentiate lung cancer from tuberculoma by the length of the spiculation. We retrospectively reviewed the length of spiculation under the hypothesis that the length of spiculation could be a differential diagnostic point between lung cancer and tuberculoma.

MATERIALS and METHODS

CT scans of 250 patients performed during September, 1989 to August, 1992 were reviewed for pulmonary...
nodules without the knowledge on the confirmed diagnosis.
We defined spiculation as linear parenchymal strands radiating from peripheral margin of the lung mass into the surrounding lung parenchyma.
We excluded the spiculations with (a) branching pattern, (b) pleural tag, or (c) faint density (Fig. 1).
Branching pattern of spiculation was excluded because it was difficult to differentiate from pulmonary vessels. Pleural attachment of the spiculation was excluded because it was difficult to measure the length of spiculation precisely.
Thirty seven patients (27 men and 10 women) ranging in age from 35 to 80 years (mean, 60 years) fulfilled the above criteria. Cytopathologic confirmation could be obtained through bronchoscopy (9 patients), percutaneous needle aspiration (12 patients), sputum cytology (6 patients) and operation (2 patients). Eight cases were diagnosed to be tuberculoma which showed no sign of increase in size during the 1 year follow-up period.
CT scans were obtained with GE 9800 Quick scanner. All scans were performed at 1 cm intervals from the apeces to the lung base with the use of intravenously administered contrast material. Technical scan parameters were 120 kVp, 120 mA, 2-second scan time, 10mm scan thickness, 40-cm field of view, and standard reconstruction algorithm. All scans were photographed at window and level setting appropriate for mediastinum (level= -15~45HU, width= 400~450 HU) and lung parenchyma (level= -600~ -850HU, width 850 ~ 1500HU).
On the slice showing the largest diameter of the lung mass the spiculations were evaluated in regard to (a) the number of spicules, (b) the mean length of spicules, (c) the mean length of the longest spicule, (d) the percentage of the mean length of spicules to the longest diameter of mass, and (e) the percentage of the mean length of spicules to the shortest diameter of mass. Since the diameter of the mass influenced the length of spiculation, we obtained the percentage of length of spicules to mass. Parametric data were analyzed using the Student t test, and statistically significant difference was accepted when P was .05 or less.

RESULTS (Table 1)
Among the 37 patients, 23 patients (62%) had lung cancer and 14 patients (38%) had tuberculoma.
The mean number of spicules of lung cancer (mean ± standard deviation, 3.1 ± 1.9) was not significantly greater (p > 0.01; 95% confidence interval) than that of tuberculoma (2.1 ± 1.3).
The mean length of spicules of tuberculoma (mean ± S.D., 13.8 mm ± 6.7 mm) was significantly greater (p < 0.01) than that of lung cancer (5.7 mm ± 3.5 mm). There were 14 cases with the spicules more than 10 mm in length, of which 11 cases were tuberculoma (Fig. 2a). In most cases of lung cancer, the length of spicules was under 10 mm. The mean length of the longest spicule of tuberculoma (mean ± S.D., 15.6 mm ± 7.5 mm) was significantly greater (p < 0.01) than that of lung cancer (7.0 mm ± 4.0mm).
The percentage of the mean length of spicules to the longest diameter of tuberculoma (mean ± S.D., 63.6% ± 40.7%) was significantly greater (p < 0.01) than that
Table 1. Analysis of spiculation

<table>
<thead>
<tr>
<th>Analysis of spiculation</th>
<th>Lung cancer</th>
<th>Tuberculoma</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean length of spicules</td>
<td>5.7mm</td>
<td>13.8mm</td>
<td>p &lt; 0.01</td>
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<tr>
<td>Mean length of the longest spicule</td>
<td>7.0mm</td>
<td>15.6mm</td>
<td>p &lt; 0.01</td>
</tr>
<tr>
<td>Mean length of the longest spicules</td>
<td>13.7%</td>
<td>63.6%</td>
<td>p &lt; 0.01</td>
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<tr>
<td>The longest diameter of mass</td>
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<tr>
<td>Mean length of the longest spicules</td>
<td>17.3%</td>
<td>68.3%</td>
<td>p &lt; 0.01</td>
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<tr>
<td>The shortest diameter of mass</td>
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<tr>
<td>Mean length of the longest spicules</td>
<td>18.3%</td>
<td>90.4%</td>
<td>p &lt; 0.01</td>
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<tr>
<td>The shortest diameter of mass</td>
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</tr>
<tr>
<td>Number of spicules</td>
<td>3.1</td>
<td>2.1</td>
<td>p &lt; 0.01</td>
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DISCUSSION

Spiculation has been known as the characteristic finding of lung cancer in the past, but it has been frequently reported also in tuberculoma. In our cases, spiculation was identified in 14 cases of tuberculoma and it was not easy to differentiate lung cancer from tuberculoma on the basis of the spiculation being present or not. However, we could differentiate lung cancer of lung cancer (13.7% ± 8.6%). The relative ratio of the mean length of spicules to mass diameter was above 25% in most cases of tuberculoma and it was below 25% in lung cancer (Fig. 2b). The percentage of the mean length of spicules to the shortest diameter of tuberculoma (mean ± S.D., 90.4% ± 64.2%) was significantly greater (p < 0.01) than that of lung cancer (18.3% ± 15.2%).

Fig. 2. a. The mean length of spicules.
b. The percentage of the mean length of spicules to the longest diameter of tuberculoma.

Fig. 3. Long spicules in tuberculoma, whereas short spicules in lung cancer:
a. In the tuberculoma, mean length of spicules is 27 mm.
b. In the lung cancer, 6.7 mm.
from tuberculosis by the spiculation length and the relative ratio (of the spicule length to the mass diameter). The spiculation length (Fig. 3) and the relative ratio (Fig. 4) of tuberculosis were significantly greater than that of lung cancer.

There are many published reports (1~7) on differentiation of benign from malignant lesions, and most of these suggested following criteria (2) for favoring a diagnosis of malignant tumor: (a) an intrapulmonary nodule with irregular, fuzzy borders, finger-like projections, or fine spiculations (b) a diameter of 4 cm or larger (c) a CT number of approximately 50 HU (45 to 65 HU) and (d) absence of CT evidence of calcification. But there was considerable overlap in above criteria between benign and malignant lesions. Because of the fact that many exceptions can be observed in each individual criterion, the diagnosis of probable malignant lesion can be made with considering many criteria.

Spiculation was observed in seventy two out of the eighty two primary carcinomas and two out of the three metastases, but was also present in four out of the five tuberculosis lesions and in one out of the two inflammatory pseudotumor by Charles (1). In Keiko Kuriyama's report (8), spiculation was seen in 78% of small peripheral lung cancers. All of the papillary adenocarcinomas had spiculations. The spiculated margins were due to the tumor invasion of the surrounding lung tissue. Stanley (9) observed the edge analysis that 52 out of 66 nodules with sharp and smooth margin were benign, but 14 (21.2%) out of 66 nodules were malignant. Although there was considerable overlap in edge characteristics (10) of each type of lesion, the majority of primary bronchogenic carcinoma had spiculated margins, whereas only a minority of carcinoid tumors, metastatic nodules, and benign lesions did so. The shaggy margins of malignant neoplasm are related to the so-called corona radiata (11). This sign consists of a number of fine, linear striations that extend perpendicularly outward from the periphery of a nodule for a distance of perhaps 4 or 5 mm. While the corona radiata is not diagnostic of malignancy (also seen in the lesions of progressive massive fibrosis of silicosis and in lipid pneumonia), it constitutes a highly suggestive sign that should be regarded with a high index of suspicion. However, as pointed out by Heitzmann (12), its presence does not constitute a pathognomonic sign of malignancy.

Pathologically (1), spiculation most commonly is correlated with a desmoplastic response in the nodule, resulting in fibrotic strands radiating into the surrounding lung parenchyma. Among malignant lesions, spiculation is occasionally associated with direct infiltration of the tumor into adjacent bronchovascular sheaths or localized lymphangitic extension. Unfortunately, there is not distinguishable from spiculation due to a fibrotic response. Among benign lesions, spiculation is due exclusively to a desmoplastic response.

There has not been any published reports on spiculation length. Although the exact cause of the longer spiculation in tuberculosis is not known, authors hypothesize that the tuberculosis is associated with longer stranded parenchymal scarring.

Although we have found that the longer spiculation is a suggestive finding of tuberculosis rather than lung cancer, the distinction of a tuberculosis from lung cancer cannot be made only by the spiculation length (Fig. 5).

Conclusively it is hard to differentiate lung cancer
from tuberculoma on the basis of the spiculation being present or not, but we suggest that the longer spiculations be highly suggestive of tuberculoma rather than cancer. The length of spiculation may help us differentiate lung cancer from tuberculoma.

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대한방사선의학회지 1994; 31(1): 63~67

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   □ 비뇨생식계   □ 근골격계   □ 소아   □ 핵의학   □ 유방   □ 기타

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