RADIOGRAPHIC EVIDENCE OF CALCIFICATION IN PULMONARY HAMARTOMAS

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Eight cases of solitary intrapulmonary hamartomas are presented to show the unusually high frequency of calcification (75%, six of eight cases) in this series. Possible contributory factors were high percentage of chondromatous variant (seven of eight cases), large size of the tumors, and use of computed tomography. (*J Natl Med Assoc.* 1992;84:329-331.)

Key words • intrapulmonary hamartomas • nodules • calcification

Pulmonary hamartoma is a well-defined solitary nodule located in the lung parenchyma, often subpleural, that measures less than 4 cm in diameter.[1,2] Differentiation of such a benign pulmonary nodule from the more common bronchogenic carcinoma is important. Presence of radiographic evidence of calcification, particularly popcorn calcification, should favor the diagnosis of a pulmonary chondromatous hamartoma instead of a lung cancer.[3] It is generally believed that calcification can only be detected in a small percentage of pulmonary hamartomas by conventional radiography.[2,4-9] Over the past 15 years, one of the authors has seen eight cases of intrapulmonary hamartomas. Six of these cases exhibited radiographic evidence of calcification. Therefore, it would seem that calcification in pulmonary hamartoma is not as rare as previously thought.

PATIENTS

Relevant clinical information of eight patients with intrapulmonary hamartomas encountered by one of the authors (MSS) is summarized in Table 1. Five tumors were located in the right lung and three in the left lung. The tumors varied in size from 1.5 cm to 6 cm. All of these lung lesions were discovered incidentally by routine chest radiography. One patient was admitted for upper gastrointestinal bleeding; another patient was admitted for coronary artery bypass grafting. Three patients suffered from chronic cough; two of these were long-term heavy cigarette smokers, their chronic cough probably the consequence of tobacco abuse. The third patient with chronic cough was not a smoker. His symptoms were likely the result of bronchial compression by a more centrally located large (6 cm) hamartoma in the superior segment of left lower lobe (Case 3). Therefore, all but one of these pulmonary hamartomas can be considered asymptomatic.

RADIOGRAPHIC FINDINGS

Seven of the eight solitary pulmonary nodules were located in the periphery of the lung; the remaining nodule was located closer to the hilum. None of the lesions were endobronchial. The lesions were round or ovoid with a well-defined smooth or slightly lobulated outline. Two small nodules (1.5 cm and 2 cm in diameter) were homogeneous in density with no evidence of calcification (Cases 1 and 2). Characteristic popcorn calcification was noted in Cases 6, 7, and 8. An example of popcorn calcification is shown in the Figure (Case 7). Such popcorn calcifications were easily detected on plain films. Calcification of the round pulmonary nodule in Cases 4 and 5 was irregular but less intense. No calcification could be detected in the large tumor in Case 3 by conventional radiography. However, stippled calcification was clearly demonstrated in the same tumor by computed tomography (CT).

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TABLE 1. SUMMARY OF CLINICAL INFORMATION, RADIOGRAPHIC MANIFESTATION, AND PATHOLOGICAL DIAGNOSIS OF EIGHT PATIENTS WITH INTRAPULMONARY HAMARTOMAS

Case No.	Age/ Sex	Symptoms	Location	Size (cm)	Radiographic Manifestation	Pathological Diagnosis	Intervention
1	56/F	Asymptomatic	RLL	1.5	Ovoid nodule with no calcification	Leiomyomatous hamartoma	Shelled out
2	60/F	Smoker with chronic cough	LLL	2	Round smooth nodule with no calcification	Chondromatous hamartoma	Shelled out
3	55/M	Chronic cough	LLL	6	Ovoid nodule with smooth margin CT: stippled calcification	Chondromatous hamartoma	Resection
4	50/M	Asymptomatic	RML	3	Round nodule with irregular calcification	Hamartoma*	Follow-up for 2 years with no change
5	66/M	Upper GI bleeding	RLL	1.5	Solitary nodule with irregular calcification	Hamartoma with calcification	Resection
6	53/F	Asymptomatic	LLL	3	Solitary nodule with popcorn calcification	Hamartoma*	Follow-up for 3 years with no change
7	45/M	Smoker with chronic cough	RLL	3.5	Solitary nodule with popcorn calcification	Hamartoma with calcification and ossification	Resection
8	49/M	Ischemic heart disease	RML	2.5	Solitary nodule with popcorn calcification	Hamartoma*	Follow-up for 3 years with no change

Abbreviations: F = female, M = male, RLL = right lower lobe, LLL = left lower lobe, RML = right middle lobe, and GI = gastrointestinal.
*Presumptive diagnosis.

PATHOLOGICAL FINDINGS

Five of the eight pulmonary nodules were either surgically resected or shelled out. Reasons for surgical removal included noncalcified (Cases 1 and 2), slightly calcified coin lesions (Case 5), and bronchial compression by the tumor (Case 3), but were uncertain in Case 7 because of the unavailability of the old medical records. One nodule was composed of primarily smooth muscles and was, therefore, a leiomyomatous hamartoma (Case 1). No calcification was noted in this tumor histologically. The remaining four tumors were predominantly composed of lobules of mature hyaline cartilage separated by fibrovascular septa and clefts lined by bronchial type epithelia. Chondromatous hamartomas in Cases 3, 5, and 7 showed extensive calcification. Ossification with bone marrow formation was noted in Case 7. Although no tissue diagnosis was made in Cases 4, 6, and 8, characteristic popcorn or irregular calcification, peripheral location, absence of central cavitation, and stationary size over a period of 2 to 3 years support the presumptive diagnosis of a benign intrapulmonary hamartoma.

DISCUSSION

Pulmonary hamartomas occur approximately once in every 400 individuals.[1] This benign tumor can be intrapulmonary or endobronchial, and may contain predominantly cartilage, smooth muscle, or vasculature.[1,2] Intrapulmonary chondromatous hamartoma is the most common variant; seven of the eight tumors in this series were this type. The remaining nodule was a rare intrapulmonary leiomyomatous hamartoma (Case 1). The majority of such intrapulmonary hamartomas are solitary, minute, peripheral in position, produce no symptoms, and are found in routine chest radiographs or at post mortem.[1,2] The exception to the general rule is the patient (Case 3) who suffered from chronic cough secondary to bronchial compression by a large centrally located hamartoma.

Calcification is an important criterion in the differential diagnosis of solitary pulmonary nodules. Radiographic evidence of cacification in pulmonary hamartomas, however, varies greatly in different reported series (Table 2). It ranges from as low as 3% to as high as 32%, with an overall incidence of 20% (119 of 584 cases).[2,4-10] In the small series reported here, the incidence is 75% (six of eight cases). Four of the patients showed popcorn calcification. Because popcorn calcification is so characteristic of pulmonary hamartoma, a confident presumptive diagnosis can be

TABLE 2. INCIDENCE OF RADIOGRAPHIC EVIDENCE OF CALCIFICATION IN SEVEN SERIES OF PULMONARY HAMARTOMAS

Reference	No. of Patients	No. Calcified (%)
Blair & McElvein, 1963[4]	25	2 (8)
Steele, 1963[5]	17	1 (6)
Poirier & van Ordstrand, 1971[6]	80	7 (9)
Shah et al, 1973[7]	10	1 (10)
Gudbjerg, 1961[8]	289	41 (14)
Bateson, 1965[9]	47	12 (25)
Bateson & Abbott, 1960[2]	116	55 (32)
Total	**584**	**119 (20)**

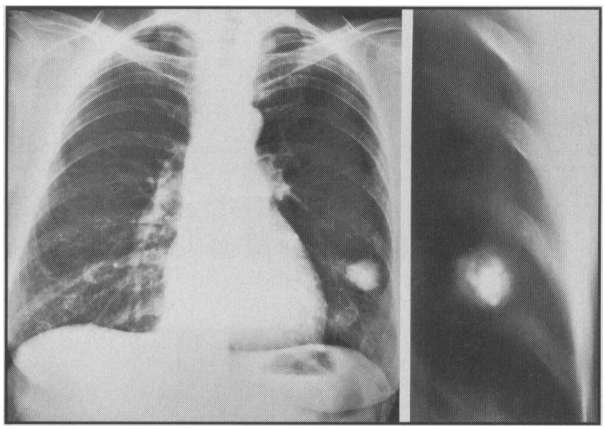

Figure. Chest radiograph (left) of a 45-year-old male (Case 7) showing a round 3.5-cm solitary nodule in the superior segment of the right lower lobe with popcorn calcification. A tomograph (right) shows the detail of the popcorn calcification of the nodule.

made without tissue examination, and patients can be managed with conservative follow-up without surgical intervention as demonstrated in Cases 4, 6, and 8.

The reason for the high incidence of calcification in our patients with intrapulmonary hamartomas is not clear. The following three factors might be contributory:

- Among the components of a pulmonary hamartoma, cartilage is most subjective to calcification and ossification. Calcification in leiomyomatous hamartoma is rare. Case 1 is such an example. In this series, all of the patients except Case 1 had chondromatous hamartomas. Other series might contain less proportion of such tumors, resulting in a lower incidence of calcification.
- In this series, two pulmonary hamartomas that exhibited no evidence of calcification were $\leq$2 cm in size while those $\geq$2.5 cm contained calcified areas. As reported by Bateson and Abbott,[2] the percentage of hamartomas with calcification increased proportionally with increase in tumor size. When the tumors reached >5 cm, calcification occurred in 75%. In this series, Case 5 was an exception, as this tumor was only 1.5 cm in diameter, yet showed calcification.
- Computed tomography scanning has been shown to be more sensitive than standard tomography in detecting calcification.[11] The stippled calcification of the hamartoma in Case 3 was not detected by conventional chest radiography but was clearly shown by CT. Among the seven series of pulmonary hamartomas reported, only one was studied with thin section CT, which showed calcification in 25% of the tumors (12 of 47 cases).[10] Wide use of CT in the future should lead to a higher frequency of calcification in pulmonary hamartomas.

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