Journal of Computer Assisted Tomography
25(2):311–313

Minute Pulmonary Meningothelial-Like Nodules: Thin-Section CT Appearance

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Abstract: Minute pulmonary meningothelial-like nodules are often incidentally discovered during pathologic evaluation of pulmonary parenchymal specimens. These lesions were once thought to represent pulmonary chemodectomas, but pathological studies have shown that they are not of neuroendocrine origin. Minute pulmonary meningothelial-like nodules are benign, perhaps reactive in nature, but are occasionally found in association with lung carcinoma. They may appear as randomly distributed well-defined micronodules on thin-section chest CT, and thus may simulate metastatic disease when associated with lung carcinoma. **Index Terms:** Tomography, X-ray computed—Lung neoplasm—Nodule—Paraganglioma.

Minute pulmonary meningothelial-like nodules are often incidentally discovered during pathologic evaluation of pulmonary parenchymal specimens. These lesions are benign, perhaps reactive in nature, but are occasionally found in association with lung carcinoma. They may appear as randomly distributed well-defined micronodules on thin-section chest CT and thus may simulate metastatic disease when associated with lung carcinoma.

The term "minute pulmonary meningothelial-like nodules" (so-called "minute pulmonary chemodectoma") describes the presence of multiple small interstitial nodules closely resembling meningothelial cells (1,2). Initially thought to be related to paragangliomas (3), it is now known that minute pulmonary meningothelial-like nodules are distinct from paragangliomas and carcinoid tumors (1,2) but are ultrastructurally and immunocytochemically similar to meningeal arachnoid cells (meningothelial cells). Although these lesions have been thought to represent benign neoplasms, recent clonal analysis suggests that multiple pulmonary meningothelial-like nodules (MPMNs) are more likely reactive in nature (4). The prevalence of these lesions in pathologic series ranges from 0.3 to 4%, and autopsy studies have reported MPMNs in association with chronic pulmonary thromboemboli, severe cardiac disease, and bronchogenic carcinoma (2,3,5). For example, in a recent series of 357 cases of primary bronchogenic carcinoma (4), MPMNs were found in association with 10% of adenocarcinomas and 3.5% of squamous cell carcinomas (4).

Although minute meningothelial-like nodules are well known in the pathologic literature, to our knowledge, radiographic descriptions of these tumors are lacking. We report a case of multiple minute meningothelial-like nodules mimicking the appearance of metastases on thin-section chest CT in a patient who underwent resection for bronchogenic carcinoma.

CASE REPORT

A 64-year-old woman presented with a complaint of shortness of breath. Her past medical and surgical histories were remarkable only for gastroesophageal reflux and hysterectomy. She had a 50 pack-year history of smoking. The physical examination and laboratory data were within normal limits. Chest radiography revealed an ill-defined right upper lobe nodule. A chest CT with thin sections though the region of the nodule was performed (Fig. 1A). CT demonstrated a 1 cm noncalcified nodule in the apical segment of the right upper lobe, corresponding to the plain radiographic abnormality. Additionally, numerous micronodules with a random distribution (6) were visible in the upper lobes bilaterally on the thin-section images; these nodules were not clearly visible with 7 mm collimation. These nodules appeared solid, sharply circumscribed, and all measured <3 mm in diameter. The remainder of the lung parenchyma was unremarkable, and there was no evidence of mediastinal or hilar adenopathy. The right upper lobe nodule was suspicious for carcinoma. Although the micronodules were considered suspicious for hematogenously disseminated metastases or, less likely, disseminated infection, because their histology was indeterminate, the patient was referred for surgery.

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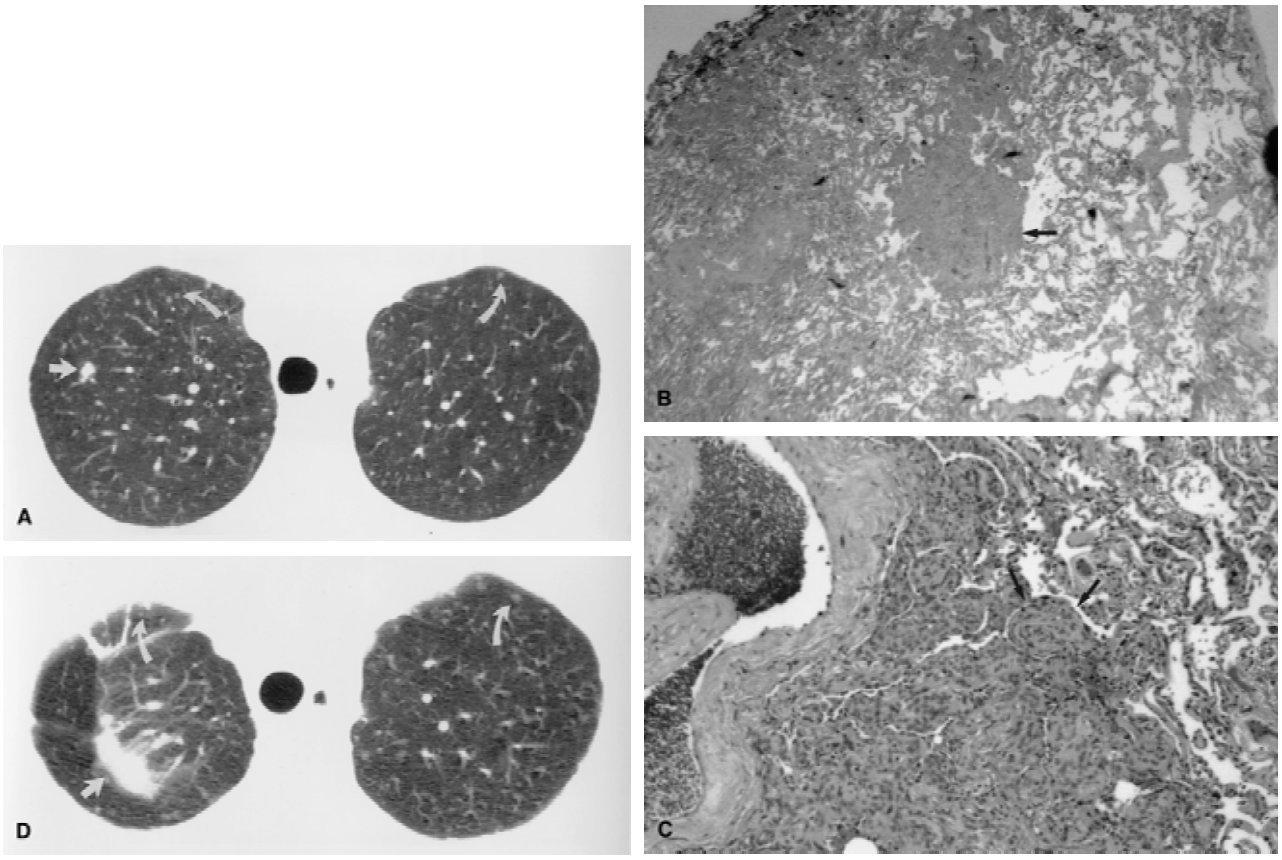

FIG. 1. A 67-year-old woman with lung carcinoma. **A:** Thin-section chest CT scan (1 mm collimation, window level = –700 HU, window width = 1,000 HU) demonstrates 1.2 cm right upper lobe adenocarcinoma (straight arrow) as well as bilateral solid micronodules (curved arrows) pathologically shown to represent meningothelial-like tumors. **B:** Photomicrograph of pulmonary specimen from the right upper lobe resection demonstrates isolated minute meningothelial-like pulmonary nodule (arrow). Hematoxylin-eosin; ×5. **C:** Photomicrograph of pulmonary specimen reveals "whorled" appearance (arrow) characteristic of meningothelial cells. Histologic appearance is reminiscent of meningioma. Hematoxylin-eosin; ×20. **D:** Chest CT scan (1 mm collimation, window level = –700 HU, window width = 1,000 HU) 8 months after right upper lobe wedge resection. Opacity in the right upper lobe is consistent with postsurgical scar. Numerous randomly distributed micronodules are again evident (arrows) and unchanged from prior examination (A).

She underwent right upper lobe wedge resection. The gross specimen revealed a 1.2 cm right upper lobe nodule that histopathologically represented moderately well-differentiated adenocarcinoma. Histopathologically, the micronodules seen on the CT scan represented multiple benign minute pulmonary meningothelial-like nodules (Fig. 1B and C). The carcinoma was staged Ia. The patient's postoperative course was uneventful. She refused the recommended complete lobectomy. Follow-up chest CT 8 months after resection showed an irregular opacity in the right upper lung consistent with postsurgical changes but no evidence of recurrent carcinoma (Fig. 1D). The micronodules were again visible but unchanged. One year after surgery, the patient is doing well.

DISCUSSION

Minute pulmonary meningothelial-like tumors or nodules, previously known as minute pulmonary chemodectomas, are of uncertain etiology. They were first described in 1960 by Korn et al. (3) as multiple lesions within the pulmonary interstitium, closely associated with pulmonary vessels. On the basis of their cytologic characteristics, cellular organization, and relationship to vessels, these tumors were thought to represent benign proliferations of chemoreceptor cell precursors. Subsequent studies have shown that these tumors have no endocrine granules and are not related to paragangliomas (1,2). Ultrastructurally and immunohistochemically, they closely resemble meningothelial cells (1,2); thus, a new term, minute meningothelial-like nodules, was proposed (2).

Because minute pulmonary meningothelial-like nodules possess an ultrastructural resemblance to meningothelial or arachnoid cells, their location within the pulmonary parenchyma raises questions regarding the cell of origin (2). Meningothelial cell proliferations outside the CNS have been thought to be related to heterotopic nests of arachnoid cells, and extracranial and extraspinal meningothelial cell proliferations are exceedingly rare and are generally limited to the head and neck (2). The relationship of meningothelial-like pulmonary nodules to pulmonary meningiomas has also been questioned (2,4). Pulmonary meningiomas are far larger than minute me-

ningothelial-like pulmonary nodules and are usually surrounded by normal lung (2). Furthermore, pulmonary meningothelial-like nodules are multiple, whereas pulmonary meningiomas are usually solitary (7). Investigators (2) have observed that if these two lesions are related, one would expect to find nodules ranging in size from the 0.1 to 3 mm size range characteristic of meningothelial-like pulmonary nodules to the larger sizes (4 cm) of resected pulmonary meningiomas. However, reports of resected pulmonary meningiomas have not documented this occurrence (2,7). Finally, given the relative frequency of minute pulmonary meningothelial-like nodules, if these lesions were precursors for pulmonary meningiomas, one would expect a far greater number of reported cases of pulmonary meningioma (2).

Minute pulmonary meningothelial-like nodules generally range in size from 100 μm to 3 mm in diameter and are located within the interstitium (1,2,8). The prevalence of these lesions in pathologic series varies from 0.3 to 4% cases and is probably greater than 1 in 100 autopsy cases (2,3,5). The variability in the prevalence of these lesions probably relates to differing numbers of random histologic sections studied with pathologic examination as well as the scrutiny with which these lesions are searched for grossly (2). Autopsy studies have reported MPMNs in association with chronic lung diseases such as chronic pulmonary thromboemboli, severe cardiac disease, and carcinomas (2,5). A recent study of 357 cases of primary bronchogenic carcinoma found MPMNs in association with 10% of adenocarcinomas and 3.5% of squamous cell carcinomas (4). A clonal study of these lesions suggested that MPMNs are more likely reactive than neoplastic (4).

As in the present case, minute pulmonary meningothelial-like nodules are frequently multiple, are encountered more often in women (5:1 female/male ratio), and are most frequently seen in the sixth decade of life (2). Upper lobe predominance has also been reported (2).

Their small size and association with other pulmonary pathologies that may result in a small nodular pattern on imaging studies probably account for the lack of description of minute pulmonary meningothelial-like nodules in the radiologic literature. These lesions presented in a random distribution (6) and were incidentally discovered during the course of a preoperative evaluation for bronchogenic carcinoma in the present case. Although the left upper lobe nodules were not sampled histologically, they were stable over a period of 1 year and similar in morphology to the lesions noted in the right lung. Therefore, the left upper lobe nodules presumably represented meningothelial-like nodules as well.

The findings of an ill-defined nodule in the right upper lobe associated with numerous, randomly distributed, small nodules raised the possibility of carcinoma with metastatic disease. Conceivably, once the diagnosis of carcinoma in the right upper lobe was established, the patient might have been denied curative surgery based on the presence of these nodules. This pitfall may be avoided with awareness of the prevalence and imaging characteristics of minute pulmonary meningothelial-like nodules. When this situation is encountered, a procedure that may sample the dominant lesion as well as a small amount of surrounding lung parenchyma containing associated micronodules may be the preferred diagnostic strategy.

CONCLUSION

Minute pulmonary meningothelial-like nodules may appear as solid micronodules <3 mm in diameter, with a random, upper lobe-predominant distribution on thin-section chest CT scans. They may be associated with other chronic pulmonary conditions or bronchogenic carcinoma. Preoperative awareness of the imaging appearance of these lesions may increase the likelihood of choosing a management strategy that will avoid incorrectly staging patients concurrently diagnosed with bronchogenic carcinoma.

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