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Mycobacterium avium-intracellulare Complex: Evaluation with CT[1]

Pulmonary *Mycobacterium avium-intracellulare* (MAI) complex has been reported with increasing frequency, but computed tomographic (CT) evaluation of pulmonary MAI complex has been seldom reported. The authors retrospectively reviewed chest CT examinations performed in 62 patients with positive MAI cultures within 1 month of CT. Of the 62 patients, 40 had bronchiectasis and 60 had infiltrates, usually of the nodular variety (39 patients). All 35 patients with small nodular infiltrates had bronchiectasis. These 35 patients did not have concurrent malignancy or clinical evidence of immunocompromise, and 29 (83%) of them were women (mean age, 66 years). Of the 27 patients without small nodular infiltrates and bronchiectasis, 25 had underlying malignancy or immunocompromise. The predominance of older women without underlying malignancy or immunocompromise but with findings of small nodular infiltrates and bronchiectasis at chest CT may indicate such patients to be a subtype of patients with pulmonary MAI complex.

Index terms: Acquired immunodeficiency syndrome (AIDS), 60.2518 • Lung, diseases, 60.203, 60.2518, 60.26, 60.281 • Lung, infection, 60.203, 60.2518 • Mycobacteria, 60.203

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In recent years, there has been an increased incidence of reported pulmonary *Mycobacterium avium-intracellulare* (MAI) complex. In some areas of the United States, MAI complex is more common than *Mycobacterium* tuberculosis (1–3). There is a recognized association of MAI complex with chronic pulmonary disease, including chronic obstructive pulmonary disease and bronchiectasis (4), and there is also an association with immunocompromised patients, especially in the population with acquired immunodeficiency syndrome (AIDS) (5). MAI complex has also been reported in patients without these predisposing conditions (6,7).

Previous investigations of the radiologic features of MAI complex have focused primarily on the radiographic appearance of the chest. The most common radiographic findings have been relatively nonspecific alveolar or nodular infiltrates (8–10), with the nodules frequently cavitated (8–10). The presence of MAI complex in pulmonary secretions has been classified as a colonized condition rather than an infection, because of negative results at chest radiography (7), but recently it has been reported that disseminated disease in the AIDS population may often be associated with negative chest radiographic findings (11).

Reports on computed tomographic (CT) evaluation of patients with MAI complex have been limited (12). Therefore, we reviewed chest CT examinations performed in such patients during a 4-year-period at our institution. We describe the CT findings of infiltrates and bronchiectasis in this group.

MATERIALS AND METHODS

We reviewed the medical records of all patients who had cultures positive for MAI during the period of June 1, 1986, to May 31, 1990. Cultures were considered positive if multiple colonies of MAI were demonstrated on any of the following: cultures of sputum, induced sputum, bronchial washings, or lung biopsy with tissue culture. Two hundred sixteen patients met the criteria. Of the 216 patients, 151 were excluded because CT examination of the chest had not been performed, and three others were excluded because the examination was performed more than 1 month after the patients were shown to have cultures positive for MAI. Sixty-two patients had undergone at least one CT examination of the chest within 1 month of having been shown to have cultures positive for MAI.

CT examinations were identified according to whether conventional or high-resolution CT (HRCT) (1.0–1.5 collimation with high-spatial-frequency reconstruction algorithm) or both were performed. Thirty patients underwent conventional CT examination, 21 underwent HRCT examination, and 11 underwent an examination that included both conventional and HRCT sections. Each lobe of the lungs was evaluated; the lingula was evaluated separately from the left upper lobe. CT was performed with either a 1200 SX (Picker, Highland Heights, Ohio) or 9800 Quick (GE Medical Systems, Milwaukee, Wis) system.

Pulmonary infiltrates were reported as present or absent and were described as areas of linear (interstitial), alveolar (air space), nodular (multiple, well-circumscribed, parenchymal nodules), reticulonodular (combination of linear and nodular patterns), or ground-glass (homogeneous infiltrate without air bronchograms or obscuration of vasculature) attenuation. The nodular infiltrates were divided into three categories on the basis of diameter: majority of nodules smaller than 5 mm, majority of nodules 5–10 mm, and majority of nodules larger than 10 mm. When the nodular infiltrates were evaluated, an attempt was made to distinguish true pulmonary nodules from the nodular opacities that may result from transaxial sections through mucoid impactions in small distal airways (13). The pres-

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Abbreviations: AIDS = acquired immunodeficiency syndrome, HRCT = high-resolution CT, MAI = *Mycobacterium avium-intracellulare.*

Prevalence of Small Nodular Infiltrate and Bronchiectasis in the Same Lobe

Right Lung		Left Lung	
Lobe	No. of Patients	Lobe	No. of Patients
Upper	19	Upper	12
Middle	21	Lingula	15
Lower	14	Lower	15

ence, location, and type (cylindric, varicose, or cystic) of bronchiectasis were also recorded (14).

The medical records of all patients were reviewed to identify those with concurrent malignancies or immunodeficiency states. Other variables that were noted included adenopathy, calcified nodes or nodules (or both), emphysematous changes, and hiatal hernia.

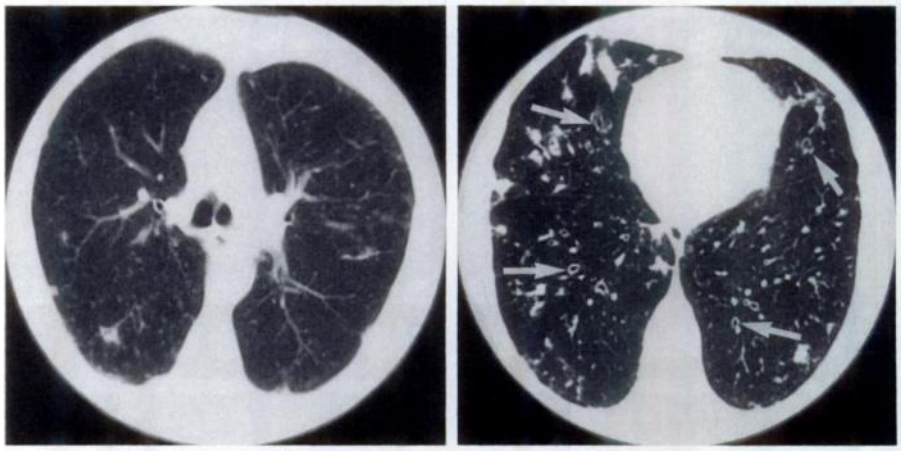


Figure 1. (a) Conventional CT scan and (b) HRCT scan obtained in a 69-year-old woman. (a) Nodular infiltrate is seen in the superior segment of the right lower lobe and in the left upper lobe. (b) HRCT scan at a level approximately 3 cm caudal to that in a shows bronchiectasis (arrows) in all lobes.

RESULTS

There were 62 patients (35 women and 27 men) included in our study, with a mean age of 66 years (range, 28–86 years).

In addition to positive MAI cultures for all 62 patients, additional organisms were cultured in 21 cases. Three patients had positive cultures for other mycobacteria (*M chelonei* in two and *M kansasii* in one). Other positive cultures included *Staphylococcus aureus* (n = 6), *Aspergillus* (n = 5), *Serratia* (n = 2), yeast (n = 2, not otherwise identified), and one each for *Pneumocystis carinii, Blastomycosis,* and *Xanthomonas maltophilia.*

Of the 62 patients who had positive MAI cultures within 1 month of chest CT examination, 40 had evidence of bronchiectasis on CT scans. Of these 40 patients, 39 had cylindric bronchiectasis. Two patients had varicose bronchiectasis and one had cystic bronchiectasis in addition to the cylindric bronchiectasis. One patient had only varicose bronchiectasis.

Of the 62 patients, 60 had pulmonary infiltrates, and 39 of these had nodular infiltrates. One patient had cavitation. Of the 21 others with infiltrates, 10 had alveolar infiltrates, seven had linear infiltrates, three had ground-glass infiltrates, and one had reticulonodular infiltrates. None of these patients had cavitation.

In the 39 patients with nodular infiltrates, the nodules were multiple, and in 35 patients, they were predominantly smaller than 5 mm in diameter. Three patients had nodules predominantly 5–10 mm in diameter, and one had nodules predominantly larger than 10 mm.

Comparison of the bronchiectasis and nodular infiltrate groups showed that all 35 patients with small nodular infiltrates (nodules smaller than 5 mm predominant) had bronchiectasis of the cylindric variety, often in the same lobe (Table, Fig 1). None of the patients with nodular infiltrates predominantly larger than 5 mm had bronchiectasis.

Further evaluation of the patient profiles showed that the mean age of the 35 patients with small nodular infiltrates and bronchiectasis was 66 years (range, 43–86 years) and that 29 of them (83%) were women.

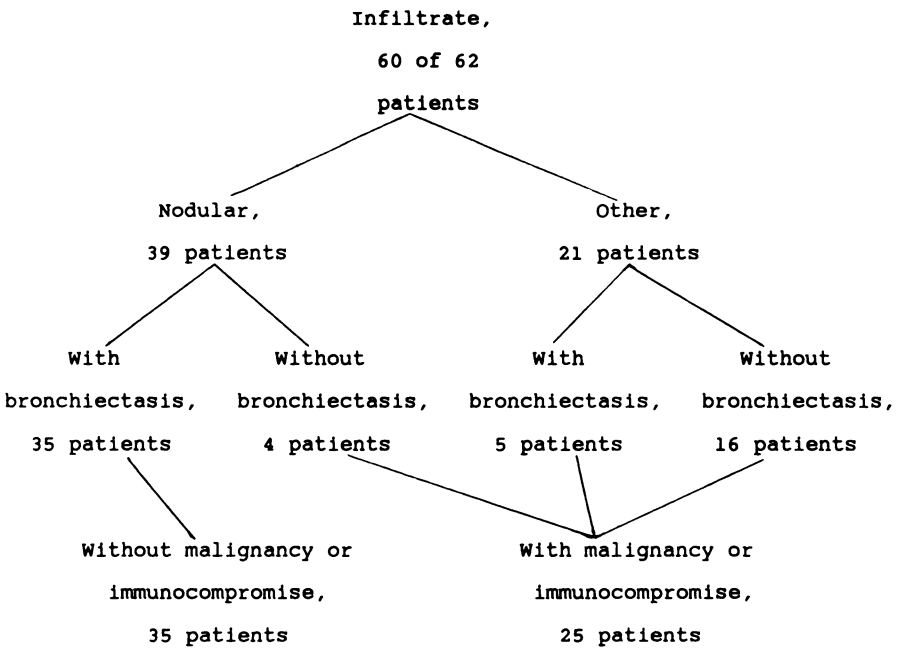
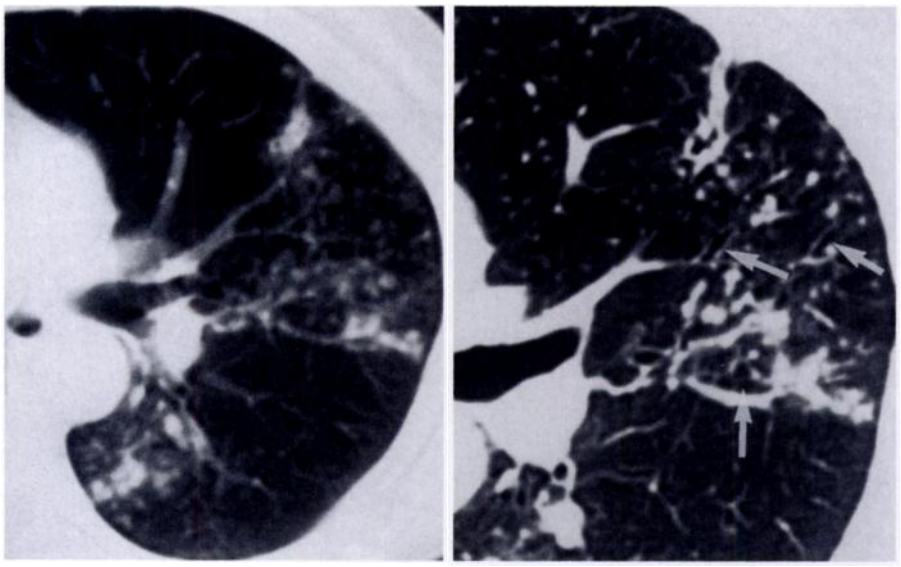


Figure 2. Grouping of patients with pulmonary MAI complex at CT.

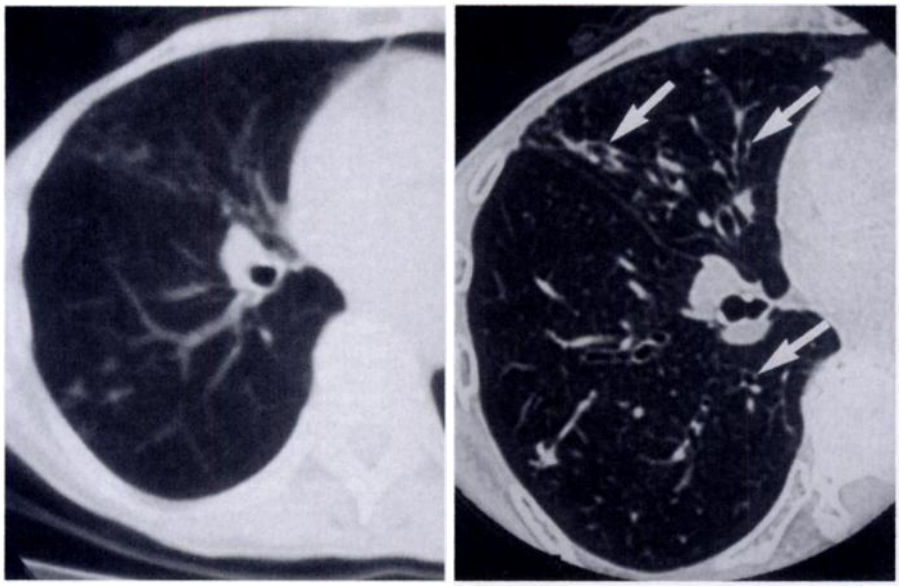
Of the 40 patients with bronchiectasis, five did not have nodular infiltrates, but two had alveolar infiltrates, two had linear infiltrates, and one had ground-glass infiltrates. Two patients had no pulmonary infiltrates, and bronchiectasis was not noted in either of them.

There were 22 patients with malignancies, the most common being hematologic (eight patients) and pulmonary cancer (five patients). The other malignancies were breast cancer in three patients, prostate cancer in two, and esophageal cancer, uterine can-



a. b.

Figure 3. (a) Conventional CT and (b) HRCT scans obtained at the same level of the left lung in a 69-year-old woman. Nodular infiltrate is seen in both **a** and **b**, but it is more readily appreciated in **a**. Bronchiectasis is evident only in **b** (arrows). (Reprinted, with permission, from reference 15.)



a. b.

Figure 4. (a) Conventional CT and (b) HRCT scans obtained at the level of the right middle lobe bronchus in a 77-year-old woman. Nodular infiltrate is seen in both scans, but bronchiectasis (arrows in **b**) can be identified confidently only with HRCT.

cer, tracheal cancer, and adenocarcinoma (unknown primary) in one patient each. Three patients had diseases that we believed indicated or caused an immunocompromised or significantly debilitated state. Two patients had alveolar proteinosis and one had an esophageal-cutaneous fistula. None of the patients in our study had AIDS. Thirty-seven patients had no underlying malignancy or clinical evidence of immunocompromise or significant debilitation (Fig 2).

CT revealed adenopathy in 17 patients, calcified nodes and nodules (or both) in 23 patients, emphysematous change in 10, and hiatal hernia in 14.

DISCUSSION

Chronic pulmonary disease and diseases causing immunocompromise have long been recognized as predisposing to MAI complex. Previous radiologic evaluation of this disease has primarily been limited to chest radiography, which has shown nonspecific nodular or alveolar infiltrates. CT provides an opportunity to further characterize the infiltrates associated with pulmonary MAI complex and to assess the relationship of these infiltrates with bronchiectasis.

Comparison of the CT findings of infiltrates and bronchiectasis allowed us to divide the 62 patients into two distinct groups. The first group (35 patients) had the common CT characteristics of a nodular infiltrate, with nodules smaller than 5 mm in diameter, and bronchiectasis. The nodular infiltrate and bronchiectasis involved at least one of the same lobes in all the patients. Although it is possible that some of the small well-circumscribed "parenchymal nodules" actually represented mucoid impactions in areas of distal bronchiectasis, the vast majority clearly were discrete parenchymal nodules. Review of the medical records demonstrated that none of these 35 patients had concurrent malignancy or clinically demonstrated immunocompromise.

In contrast, the second group (27 patients) had no characteristic infiltrate pattern; alveolar, linear, ground-glass, and reticulonodular infiltrates were all observed in decreasing order of frequency. Also, there was no specific association of these infiltrates with bronchiectasis. Two of the patients with alveolar, two with linear, and one with ground-glass infiltrates had bronchiectasis. Two other patients had no demonstrable pulmonary infiltrates, and neither patient had bronchiectasis. Also included in the second group were four patients with nodular infiltrates greater than 5 mm in diameter; none of them had bronchiectasis. Review of the medical records of this second group of patients showed that 25 of them had concurrent malignancy or immunocompromise.

Cavitation was seen in only one of the 62 patients, and this occurred in one of the patients with small nodular infiltrates and bronchiectasis. A single large cavity in the left upper lobe was seen in this patient. This discrepancy with the findings from prior chest radiographic studies showing frequent cavitation (8–10) may be due to earlier CT identification of MAI complex infection or colonization in these patients.

Adenopathy, emphysematous changes, and hiatal hernia were found more frequently in the patients with a nonspecific CT pattern. Only three patients in the first group, with a nodular infiltrate and bronchiectasis, had emphysematous changes. These changes involved less than 10%

of the lungs in each of these three patients.

Calcified nodes or nodules were seen in 14 patients (40%) of the first group and in nine patients (33%) of the second group.

Further evaluation of the patient profiles showed that the first group consisted predominantly of women (29 of 35 patients [83%]), with a mean age of 68 years (range, 54–81 years). The six men in this group had a mean age of 56 years. In the second group, there were only six women (22%). The mean age of the women in this group was 76 years (range, 63–86 years). The mean age for the 21 men in the second group was 63 years.

Our results indicate that there is a subtype of patients with MAI complex who have a characteristic pattern seen on CT scans of the chest. These patients are older, are predominantly women (83%), and have no underlying malignancy or clinical evidence of immunocompromise. CT of the chest shows nodular infiltrate with small nodules (smaller than 5 mm in diameter) in association with bronchiectasis of the cylindric variety (Figs 3, 4). CT evaluation of the chest of these patients is probably best performed by using a combination of conventional and high-resolution sections to optimally demonstrate both the nodular infiltrate and the bronchiectasis. Whereas diseases such as panbronchiolitis (16,17) and bronchiolitis obliterans (18)—especially the subset bronchiolitis obliterans organizing pneumonia (19)—can occasionally have the CT findings of small nodular infiltrates and bronchiectasis, the clinical history should allow differentiation of these entities. Panbronchiolitis has no reported association with positive MAI cultures and predominantly affects the Japanese population. In patients with bronchiolitis obliterans organizing pneumonia, review of the medical history often reveals a recent febrile illness. Additionally, on CT sections, areas of consolidation are often present in patients with this type of organizing pneumonia (16), which was not seen in our subset of patients who had positive MAI cultures, small nodules, and bronchiectasis.

At the present time, the implications for patients who are culture-positive for MAI and have CT findings of small nodular infiltrate and bronchiectasis are unclear. It is uncertain whether the infiltrates represent true granulomas and infection with MAI or merely colonization; however, a review by Moore and Müller (read at the meeting of the Society of Thoracic Radiology, Laguna Niguel, Calif, January 19–23, 1992; Moore EH, personal communication, 1992) has shown that the nodules were indeed MAI complex granulomas in at least one case. Recently, we have learned of two cases in which the small nodules were confirmed as MAI complex granulomas at open lung biopsy (Miller WT, personal communication, 1992). The indications for treatment remain controversial; identification of this subtype at CT, however, provides at least a baseline for subsequent examinations after either observation or treatment. ■

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