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Pulmonary *Mycobacterium kansasii* infection: comparison of radiological appearances with pulmonary tuberculosis

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Abstract

Background **– A study was undertaken to determine if there are differences in the radiological appearances at presentation between pulmonary infections caused by *Mycobacterium kansasii* and *Mycobacterium tuberculosis*. Correct recognition of the organism has important implications with regard to initial therapy and contact tracing.**

Methods **– The initial chest radiographs of 28 patients with pulmonary *M kansasii* infection were compared with those of 56 age, sex, and race matched patients with *M tuberculosis* infection. All patients in both groups were culture positive and none was known to be HIV positive. The radiographs were analysed independently by two radiologists who were unaware of the causative organism.**

Results **– Radiographic abnormalities in patients with *M kansasii* infection were more frequently unilateral and right side predominant, while those with tuberculosis more frequently involved a lower lobe. Air space shadowing involving more than one bronchopulmonary segment and pleural effusions were seen less frequently in *M kansasii* infection (four of 28 (14%) versus 30 of 56 (54%) and none of 28 versus 15 of 56 (27%)). Cavitation (21 of 28 (75%) versus 34 of 56 (61%)) was seen to a similar extent in patients with *M kansasii* infection and in those with tuberculosis. Cavities tended to be smaller in patients with *M kansasii* infection ($p < 0.01$).**

Conclusions **– Differences are seen in the radiographic appearances of pulmonary infection caused by *M kansasii* and *M tuberculosis*. These differences are not sufficient to allow a positive diagnosis on the basis of radiographic findings alone, but the presence of a pleural effusion or lower lobe involvement makes *M kansasii* infection very unlikely.**

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Keywords: *Mycobacterium kansasii*, *Mycobacterium tuberculosis*, pulmonary infection, radiological appearance, diagnosis.

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There is a wide geographical variation in the prevalence of the many species of non-tuberculous mycobacteria.[1] *Mycobacterium kansasii* is the commonest species causing non-tuberculous mycobacterial pulmonary infection in the United Kingdom,[2] Western Europe, and parts of the United States.[3] In 1991 *M kansasii* accounted for 21% of all mycobacterial and 64% of non-tuberculous mycobacterial pulmonary infections in those of white race seen at our institution.[4]

Early clinical identification of *M kansasii* infection would be helpful as it requires a different therapeutic regimen from *Mycobacterium tuberculosis* and contact tracing may be unnecessary.[3 5 6] There have been several previous descriptions of the radiological appearances of *M kansasii* infection but no attempt has been made to assess whether these differ from *M tuberculosis* in comparable patients. We have therefore performed a blinded comparison of the radiological appearances of infections due to *M kansasii* and *M tuberculosis* in patients matched for age, sex, and race to determine if it is possible to make a specific diagnosis at presentation.

Methods

A review of the microbiological records held at University Hospital between 1978 and 1989 revealed that *M kansasii* was isolated from the sputum of 50 patients. The chest radiographs of 34 of these patients were available for review, those of the other 16 patients having been destroyed. Each patient was matched (as closely as possible) for age, sex, and race with two control subjects (to enhance the power of the study) who had sputum cultures positive for *M tuberculosis* within two years of the time *M kansasii* was isolated. During this same period 690 patients had sputum cultures positive for *M tuberculosis*.

Two radiologists, unaware of the infecting organism, independently evaluated the presenting chest radiographs in both groups. In three cases a discrepancy occurred which could not be resolved by consensus. In these cases a third independent opinion was obtained. The radiographs were assessed for the following features: previous or coexistent lung disease, site of abnormality, loss of lung volume, air space shadowing, circumscribed opacities and cavitation, bronchopulmonary spread, drainage area disease, local pleural disease, pleural effusions, lymphadenopathy, and evidence of a primary focus. Air space shadowing was classified as small if only one bronchopulmonary segment was involved and large if more than one segment was involved. Cavities were classified according to number, size, and the presence of air fluid levels. Circumscribed opacities were measured and numbered.

Table 1 Radiological appearances of Mycobacterium kansasii and Mycobacterium tuberculosis pulmonary infections

	M kansasii (n=28)	*M tuberculosis* (n=56)	*OR*	*95% CI*	*p value*
Unilateral	20 (71%)	26 (46%)	2.60	1.02 to 6.58	0.045*
Predominant side					
Left	4 (14%)	14 (25%)	0.48	0.14 to 1.66	0.247
Right	19 (68%)	24 (43%)	3.26	1.33 to 9.44	0.029*
Neither	5 (18%)	18 (32%)	0.47	0.16 to 1.41	0.117
Lower lobe	3 (11%)	24 (43%)	0.19	0.05 to 0.66	0.009*
Subapical	24 (86%)	50 (89%)	0.69	0.16 to 2.94	0.619
Apical	22 (79%)	40 (71%)	1.48	0.49 to 4.45	0.482
Circumscribed opacity	4 (14%)	7 (12.5%)	1.14	0.33 to 3.90	0.831
Air space shadowing small	13 (46%)	15 (27%)	2.08	0.86 to 5.03	0.103
Air space shadowing large	4 (14%)	30 (54%)	0.20	0.07 to 0.6	0.004*
Volume loss	16 (57%)	30 (54%)	1.154	0.47 to 2.86	0.758
Effusion	0	15 (27%)			0.007**
Drainage area disease	11 (39%)	31 (55%)	0.55	0.22 to 1.35	0.189
Bronchopulmonary spread	2 (7%)	8 (14%)	0.47	0.09 to 2.35	0.356
Local pleural disease	16 (57%)	29 (52%)	1.24	0.50 to 3.10	0.644
Primary focus	7 (25%)	13 (23%)	1.11	0.37 to 3.35	0.850

*Statistically significant; **two tailed Fisher's exact test.

After reviewing the chest radiographs the medical records of the patients with sputum cultures positive for *M kansasii* were obtained to determine if true pulmonary infection had occurred. Five patients did not satisfy the criteria of the American Thoracic Society for diagnosis of disease caused by non-tuberculous mycobacteria[5] (multiple isolates, radiographic changes compatible with mycobacterial disease) and were excluded from the study. One patient who was HIV positive with AIDS was also excluded. The HIV status of the remaining patients was not known but no patients were members of a high risk group. The likelihood that any of these patients was HIV positive is extremely low as the prevalence of HIV infection in England and Wales outside London is currently about 0.01%.[7]

We therefore studied 28 patients with *M kansasii* infection. All were white, 75% were men, their mean age was 60 years (range 36–83), and the mean age at presentation was 57 years (range 30–83). Five patients had a history of tuberculosis, two had a history of Hodgkin's disease, two had rheumatoid arthritis (one of whom was taking corticosteroids), one had a history of alcohol abuse, and one had diabetes. The radiographic findings in these 28 patients were compared with the findings in 56 patients of mean age 57 years (range 26–87) who had *M tuberculosis* infection.

Initial descriptive analysis was performed using the Statistical Package for Social Sciences (SPSS PC version 4.0). Matched case-control analysis for binary variables was carried out by conditional logistic regression using the EGRET statistical package. Where numbers were too small for conditional logistic regression Fisher's exact (two tailed) test was used. For number of cavities and maximal cavity size data were analysed using the χ^2 test for linear trend (EPI-INFO version 6.0).

Results

The anatomical distribution of the radiological abnormalities differed between the two groups (table 1). Disease due to *M kansasii* was confined to the upper lobes (apex/subapical) in 25 of the 28 patients (89%) compared with 32 of the 56 patients (57%) with *M tuberculosis* ($p < 0.01$). Given the relative incidences of mycobacterial infections, the positive predictive value for *M tuberculosis* infection rather than *M kansasii* of lower lobe involvement was 93% (fig 1).

Of the three patients (11%) with disease outside the upper lobes in the *M kansasii* group, two were due to bronchopulmonary spread and in one with apical disease there was an accompanying bronchiectasis of the left lower lobe although infection of this lobe was not proven. Although upper lobe involvement was present in 50 of the 56 patients (89%) with *M tuberculosis,* in 19 of these disease was also present outside the upper lobes and in a further four patients disease was confined to the middle and/or lower lobes. *M kansasii* was more commonly unilateral than *M tuberculosis* (20 of 28 patients (71%) compared with 26 of 56 (46%); $p = 0.045$). Disease due to *M kansasii* was more commonly right side predominant than *M tuberculosis* (19 of 28 (68%) compared with 24 of 56 (43%); $p = 0.029$).

Further radiological findings are presented in table 1. Pleural effusions were not seen in the *M kansasii* group but were present in 15 of

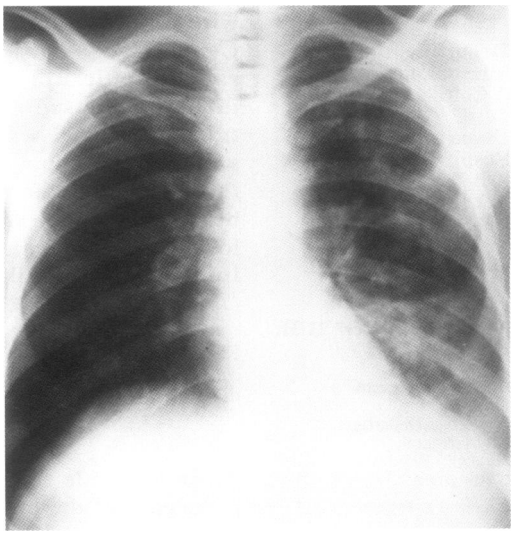

Figure 1 Chest radiograph of a patient with tuberculosis showing a left pleural effusion and left lower lobe involvement, features found less commonly in M kansasii infection than in tuberculosis.

Table 2 Cavities and evidence of previous or coexistent lung disease in Mycobacterium kansasii and Mycobacterium tuberculosis pulmonary infections

	M kansasii (n=28)	*M tuberculosis* (n=56)	*p value*
Cavities	21 (75%)	34 (61%)	0.177*
No. of cavities:			
1	7 (33%)	6 (18%)	
2–3	4 (19%)	13 (38%)	
4–5	2 (10%)	6 (18%)	
>5	8 (38%)	9 (26%)	0.986**
Size of cavities:			
<2 cm	14 (66%)	10 (29%)	
2–3 cm	6 (29%)	16 (47%)	
3.1–6 cm	1 (5%)	4 (12%)	
>6 cm	0	4 (12%)	0.006**
Air fluid level	0	5 (15%)	0.144***
Emphysema	6 (21%)	9 (16%)	
Bronchiectasis	3 (11%)	2 (4%)	
Coal worker's pneumoconiosis	1 (4%)	3 (5%)	
Asbestos exposure	0	1 (2)	
Lymphoma	1 (4%)	0	
Previous tuberculosis	3 (11%)	3 (5%)	

*OR = 2.13, 95% CI 0.71 to 6.37. **χ^2 test for linear trend; ***Fisher's exact test.

56 patients (27%) with *M tuberculosis* (p <0.01; fig 1). The positive predictive value of a pleural effusion for *M tuberculosis* rather than *M kansasii* in this series was therefore 100%. In five (9%) the effusion was the only abnormality present. Air space shadowing involving more than one bronchopulmonary segment was less common in the *M kansasii* group (four of 28) than in the *M tuberculosis* group (30 of 56, p <0.005), reflecting the more extensive involvement in the *M tuberculosis* group. Miliary disease was seen in one patient with tuberculosis but was not seen in the *M kansasii* group. Lymphadenopathy was not seen in either group.

Cavitation was present in similar proportions in both groups (table 2). There was a marked trend towards smaller cavities in the *M kansasii* group (fig 2; p <0.01). Single thin walled cavities were present equally in both groups (fig 3). Air fluid levels within cavities were not seen in the *M kansasii* group but were seen in five of 56 (9%) of the *M tuberculosis* group (fig 4).

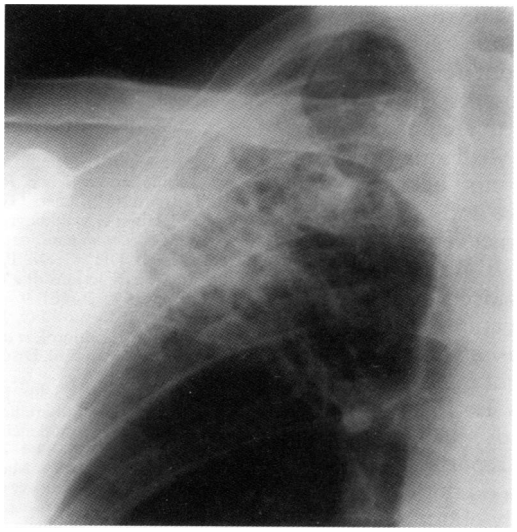

Figure 2 Chest radiograph of a patient with M kansasii infection showing multiple small cavities in the right upper lobe.

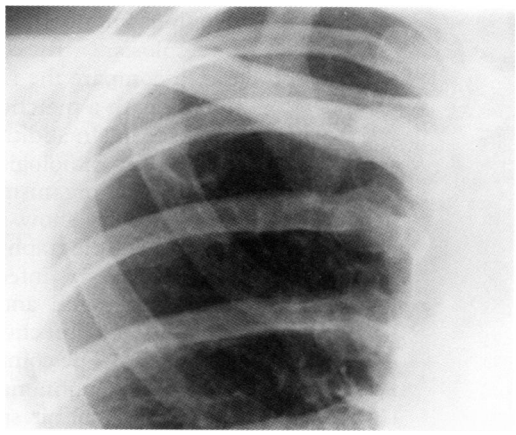

Figure 3 Chest radiograph of a patient with M kansasii infection showing a solitary thin walled cavity with no surrounding consolidation in the right upper lobe.

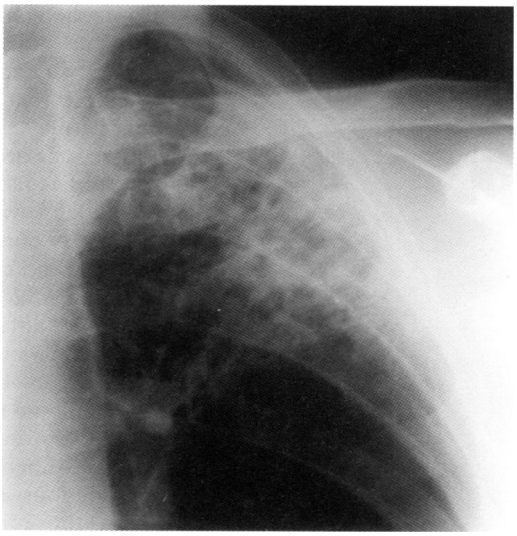

Figure 4 Chest radiograph of a patient with tuberculosis showing a large cavity in the left upper lobe containing an air fluid level, a feature not seen in M kansasii infections.

Discussion

M kansasii is the commonest non-tuberculous mycobacterium causing pulmonary infection in the UK.[2] It requires a different therapeutic regimen from *M tuberculosis* infection[6] and, as human transmission rarely if ever occurs,[8] contact tracing is unnecessary.[3] The importance of *M kansasii* infection and these differences from *M tuberculosis* infection suggest that early clinical identification of *M kansasii* would be helpful given the delay before bacteriological confirmation is available.

The radiographic features of pulmonary infections caused by *M kansasii* have been reviewed by several authors. They have been variably reported as being indistinguishable from tuberculosis[2 9 10] to having an appearance which is highly suggestive of *M kansasii* infection[10–12] or one which is quite different from *M tuberculosis* infection.[13 14] These variations in findings may, however, relate at least in part to differences in methods between these studies. Several of the studies[10 13 14] reported the radiographic features of non-tuberculous bacterial species as a single group, whereas others have described the features of *M kansasii*

infections but not directly compared them with tuberculosis.[2 8 9] By contrast, our study is the first to compare the radiological features of *M kansasii* with a matched group of patients with tuberculosis. In addition, the radiographs were reviewed by radiologists who were unaware of the infecting organism.

Our results show that there is no pathognomonic radiographic appearance in *M kansasii* pulmonary infection. The disease was usually unilateral and right sided. A similar distribution of infection was reported by Christensen *et al.*[9] The commonest radiographic presentation of pulmonary *M kansasii* infection was of minimal air space shadowing with associated cavitation confined to one or both upper lobes. In almost 90% of cases disease was confined to the upper lobes, as has generally been reported previously.[8–10] In one study 50% of patients with non-tuberculous mycobacterial infection had disease outside the upper lobes, but the study included four non-tuberculous mycobacterial species.[13] Recent evidence suggests that the radiographic features of the individual non-tuberculous mycobacterial infections are diverse.[15]

Previous studies have reported cavitation in 84–96% of patients with *M kansasii* pulmonary infections.[2 9 16] In our study 75% of patients with *M kansasii* had cavitation and neither we nor Christensen *et al*[16] found the frequency of cavitation to be different from tuberculosis. Two other previous studies[13 14] reported a much lower incidence (38–43%) of cavitating disease in non-tuberculous mycobacterial infection. These studies, however, included *M kansasii* with other non-tuberculous species and their patient populations are therefore not comparable with those in the studies reviewed above. Zvetina *et al*[11] reported that a single thin walled cavity with little surrounding parenchymal disease was highly likely to be due to *M kansasii* infection. We found solitary cavities more frequently, though not significantly so, in patients with *M kansasii* infection, as did Christensen *et al.*[16] In clinical practice, however, because tuberculosis is five times more common than *M kansasii* infection, a solitary cavity is much more likely to be due to *M tuberculosis* infection than to *M kansasii* infection. There are, however, significant differences in the appearances of cavities in patients with *M kansasii* infection and those with tuberculosis. Patients with *M kansasii* generally had smaller cavities and air fluid levels did not occur. Overall, however, the number, size and appearance of cavities was not characteristic enough to make a positive diagnosis of *M kansasii* infection.

Pleural effusions rarely occur in non-tuberculous mycobacterial infections.[5 16] Indeed, in our study no pleural effusions were seen with *M kansasii* but were present in nearly a third of patients with tuberculosis. Local or contiguous pleural disease was found equally in the two infections. Chapman[17] reported that non-tuberculous mycobacteria do not form a primary complex. In our study about a quarter of patients with either infection were found to have a primary focus but, for those with *M kansasii* infection, this may be due to previous *M tuberculosis* infection. Certainly, three of the seven patients had previously been diagnosed and treated for pulmonary tuberculosis. The association of non-tuberculous mycobacterial infections with previous mycobacterial disease has been reported.[5] Two previous studies[14 15] have reported a more disseminated infection with little associated cavitation in a group of patients with non-tuberculous mycobacterial infection. Both studies included several species of non-tuberculous mycobacteria in addition to *M kansasii* and, as the radiographic appearances in these individual infections may be diverse,[15] these patients are not comparable with those in this or other previous studies.[2 8–10 16]

Disseminated disease due to *M kansasii* infection is rarely seen but has been reported in immunosuppressed patients,[18] including those with AIDS,[19] though more than 95% of disseminated non-tuberculous mycobacterial disease in AIDS is due to the *Mycobacterium avium intracellulare* complex.[12 20]

This study shows that there are some significant differences in the radiological appearances in patients with *M kansasii* pulmonary infections when compared with matched controls with pulmonary tuberculosis. Lower lobe involvement or a pleural effusion make *M kansasii* infection very unlikely. However, those features that are more common in *M kansasii* infection do not display radiological differences that are significantly great to allow pulmonary *M kansasii* infection to be positively differentiated from tuberculosis.

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