*Pediatrics International* (2007) **49**, 363–367 doi: 10.1111/j.1442-200X.2007.02363.x

Original Article

# Mycoplasma pneumonia: Clinical and radiographic features in 39 children

SHU-CHIANG HSIEH,[1] YUNG-TING KUO,[2] MING-SHENG CHERN,[3,4] CHIA-YUEN CHEN,[1,5] WING P. CHAN[1,5] AND CHUN YU[1,5]

*Departments of [1]Radiology and [2]Pediatrics, Taipei Medical University–Municipal Wan Fang Hospital, [3]Department of Radiology, West Garden Hospital, [4]Department of Radiology, School of Medicine, National Yang-Ming University, [5]Department of Radiology, School of Medicine, Taipei Medical University, Taipei, Taiwan*

**Abstract**

***Background***: The purpose of the present paper was to evaluate the clinical and chest radiographic features of pediatric patients with serologically proven *Mycoplasma pneumoniae* pneumonia (mycoplasma pneumonia).

***Methods***: The clinical records and chest radiographs of 39 consecutive patients (19 male, 20 female; age 3–13 years) with serologically positive IgG and IgM mycoplasma pneumonia were reviewed.

***Results***: More than 90% of patients presented with fever and cough and 48% of patients had leukocyte count >10 000/mm$^3$. A C-reactive protein (CRP) level >0.375 mg/dL was noted in 28 patients (72%). Chest radiographs displayed four different patterns: (i) peribronchial and perivascular interstitial infiltrates ($n$ = 19, 49%); (ii) airspace consolidations ($n$ = 15, 38%); (iii) reticulonodular opacification ($n$ = 3, 8%); and (iv) nodular or mass-like opacification ($n$ = 2, 5%). Bilateral peribronchial perivascular interstitial infiltrations in central and middle lung zones were frequently seen ($n$ = 19, 49%). Other radiological features were bilateral lesions in 51% of patients, pleural effusion in 23%, and hilar lymphadenopathy in 13%. Means of duration for treatment response and hospitalization were 2.5 and 5 days, respectively.

***Conclusion***: There are various radiological features of mycoplasma pneumonia in children. Bilateral peribronchial and perivascular interstitial infiltrates were most frequently seen in the present patients.

**Key words** children, mycoplasma pneumonia, pneumonia, thoracic radiography.

*Mycoplasma pneumoniae* is a common and treatable cause of community-acquired pneumonia, occurring primarily in children and young adults.[1] It accounts for up to 30% of all pneumonias in the general population.[2] The highest incidence is seen in children between 3 and 14 years of age. The chest radiographic patterns of mycoplasma pneumonia are non-specific and variable, and are indistinguishable from those of bacterial and viral pneumonia.[3] Some authors have reported that a reticulonodular pattern or nodular opacities are typical radiographic patterns in mycoplasma pneumonia,[4,5] whereas others stress the occurrence of confluent or patchy consolidation.[7–9]

The aim of the present study was to evaluate the chest radiographic and clinical features of pediatric patients with serologically proven mycoplasma pneumonia.

Correspondence: Wing P. Chan, MD, Department of Radiology, Taipei Medical University–Municipal Wan Fang Hospital, 111 Hsing-Long Road, Section 3, Taipei 116, Taiwan. Email: wingchan@tmu.edu.tw

Received 28 November 2004; revised 19 January 2006; accepted 2 February 2006.

## Methods

From January 2001 to November 2002, 410 consecutive patients with seropositive findings of *Mycoplasma* Ab (microparticle agglutination test titer $\geq$40 XX) in the acute phase of illness were admitted to Taipei Medical University–Wan Fang Hospital. This titer was assessed using a commercial test kit (Serodia-Myco II; Fujirebio, Tokyo, Japan). Of these, 39 patients had seropositive findings of IgM-proven mycoplasma pneumonia (*M. pneumoniae* IgM-ELISA, Novatec Immundiagnostica, Dietzenbach, Germany) during the acute phase of illness. There were 19 boys and 20 girls, with a mean age of 6.4 years (range, 3–13 years). The clinical records and initial chest radiographs of these 39 children were reviewed. All patients were discharged from hospital when fever subsided for 2 days and their general condition became stable. All radiographic examinations were performed with conventional radiographic equipment (MU125M; Shimadzu, Kyoto, Japan) and the standard anteroposterior projection.

Two radiologists interpreted all chest radiographs without awareness of the clinical progress of the subjects, and a consensus of interpretation was reached. The observers evaluated the patterns and distribution of lung parenchymal, mediastinal, and pleural abnormalities on each chest radiograph in all subjects. The patterns of parenchymal change were classified as peribronchial and perivascular interstitial infiltrates, air-space consolidation, reticulonodular opacification, or nodular or mass-like opacification. Air-space consolidation was defined as homogeneous opacification of the parenchyma with the underlying vessels obscured, and was subdivided into subsegmental consolidations and lobar–segmental consolidations. Nodules were defined as focal round opacities.

The anatomic distribution was noted to be central if the abnormality predominantly involved the medial half of the zone and peripheral if it predominantly involved the lateral half. Abnormalities were classified as being distributed predominantly in the upper, middle, or lower lung zones, and as unilateral or bilateral. Bilateral pulmonary hila, the paratracheal space and the aortopulmonary window were evaluated for lymph node enlargement and the pleural spaces for the presence of pleural effusion.

Results are expressed as mean ± SD. Student's *t*-test was used for statistical analysis, and results were considered to be significant at $P < 0.05$.

## Results

The most common clinical findings in the present patients were cough (95%), fever (92%), and rales (67%; Table 1). Most patients had a benign course and survived. The mean hospitalization was approximately 5 days. Three patients were admitted to the intensive care unit because of coexisting pneumococcus and enterovirus encephalitis infection.

**Table 1** Initial clinical features of 39 patients with mycoplasma pneumonia

| Symptom | *n* (%) |
|---|---|
| Cough | 37 (95) |
| Fever | 36 (92) |
| Rales | 26 (67) |
| Malaise | 20 (51) |
| Rhinorrhea | 18 (46) |
| Sore throat | 13 (33) |
| Dyspnea | 12 (31) |
| Vomiting and diarrhea | 10 (26) |
| Wheezing | 5 (13) |
| Chest or abdominal pain | 5 (13) |
| Skin rash | 2 (5) |
| Headache | 2 (5) |
| Seizure | 2 (5) |

According to laboratory results the leukocyte count was >10 000/mm$^3$ in nearly half of the patients (47.5%), and >15 000/mm$^3$ in 19.5% of patients. A C-reactive protein (CRP) level >0.375 mg/dL was noted in 28 patients (72%).

The observed radiographic features included peribronchial and perivascular interstitial infiltrates ($n$ = 19, 49%; Fig. 1), air-space consolidation ($n$ = 15, 38%; Fig. 2), reticulonodular opacification ($n$ = 3, 8%; Fig. 3), and nodular or mass-like opacification ($n$ = 2, 5%; Fig. 4; Table 2).

The location of the abnormalities is given in Table 3. Peribronchial and perivascular interstitial infiltrates were noted

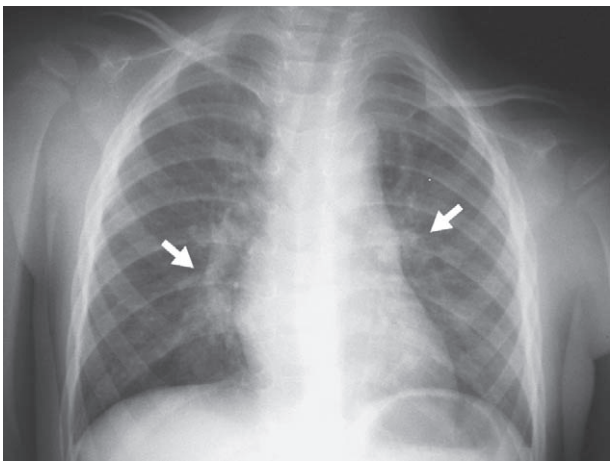

**Fig. 1** A 2 year-old previous healthy girl presented with an approximately 1 week history of fever and productive cough. Initial chest radiograph shows bilateral peribronchial and perivascular interstitial infiltrates (arrows).

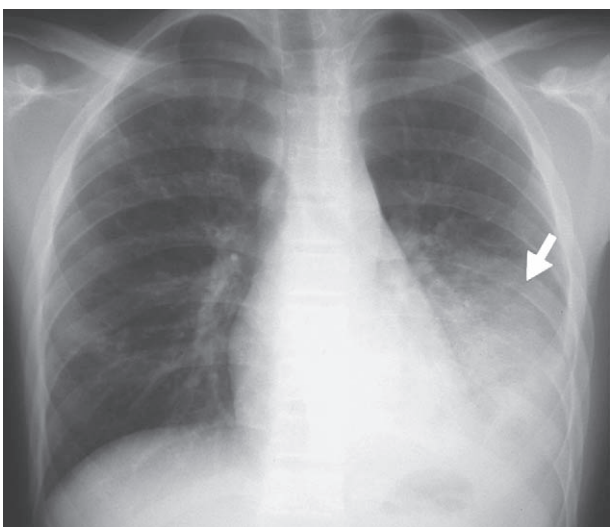

**Fig. 2** A 12 year-old boy presented with an approximately 1 week history of productive cough and rhinorrhea. Initial chest radiograph shows lobar consolidation (arrow) in the left lower lung zone with left pleural effusion.

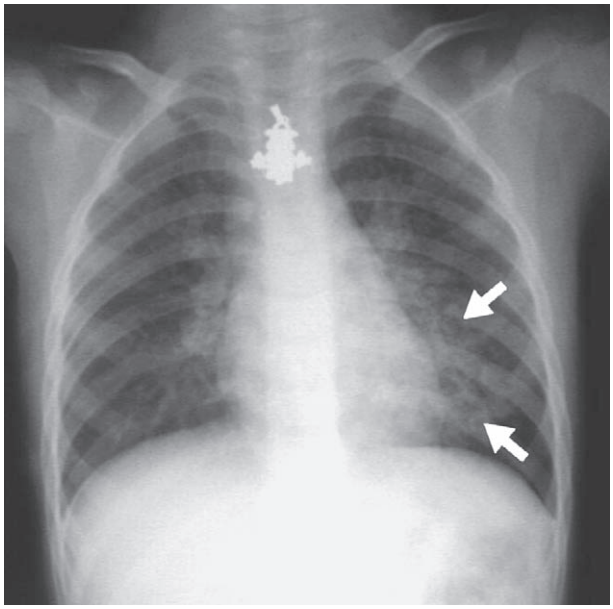

**Fig. 3** A 6 year-old boy presented with a 3 day history of high fever and productive cough. Frontal chest radiograph shows reticulonodular opacities (arrows) in the left lower lung zone. Bilateral peribronchial and perivascular interstitial infiltrates also are noted.

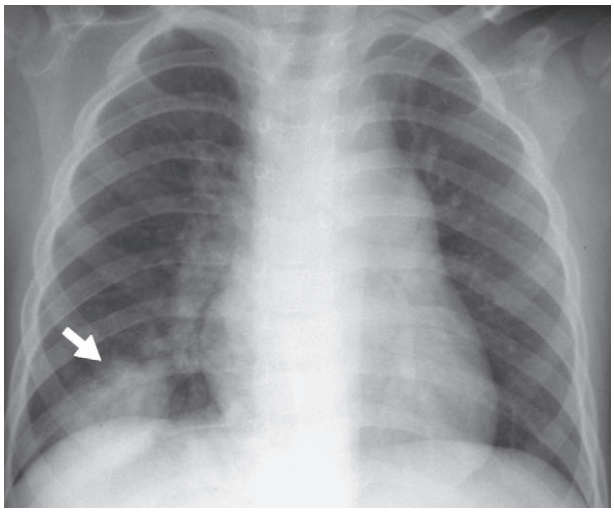

**Fig. 4** A 6 year-old boy presented with a 3 day history of fever and cough. Frontal chest radiograph shows a round mass-like lesion (arrow) in the right lower lobe.

bilaterally in the central and middle lung zones in 19 patients. Air-space consolidations were subsegmental in 23% ($n$ = 9) and lobar–segmental in 15% ($n$ = 6). Air-space consolidation involved predominantly the lower lung zones in 11 (73%) of 15 patients, the middle lung zones in one (7%), and the upper lung zones in three (20%). Reticulonodular opacifications ($n$ = 3) were located in the upper lung zone ($n$ = 2, 67%) and lower lung zone ($n$ = 1, 33%). Nodular or mass-like opacifications ($n$ = 2) were located unilaterally in the middle ($n$ = 1) and lower ($n$ = 1) lung zone. Unilateral disease ($n$ = 19, 49%) was nearly as common as bilateral disease ($n$ = 20, 51%). Pleural effusions were seen in nine (23%) patients and hilar lymphadenopathy in five patients (13%).

**Table 2** Initial radiographic findings in 39 patients with mycoplasma pneumonia

| Radiographic pattern | $n$ (%) |
|---|---|
| Peribronchial and perivascular interstitial infiltrates | 19 (49) |
| Air-space consolidation | 15 (38) |
| Subsegmental | 9 (23) |
| Lobar–segmental | 6 (15) |
| Reticulonodular opacification | 3 (8) |
| Nodular or mass-like opacification | 2 (5) |
| Associated findings | |
| Pleural effusion | 9 (23) |
| Adenopathy | 5 (13) |

**Table 3** Distribution of lung opacities on initial radiographs in 39 patients with mycoplasma pneumonia

| Distribution | $n$ (%) |
|---|---|
| Peribronchial and perivascular interstitial infiltrates ($n$ = 19) | |
| Central | 19 (100) |
| Middle lung zone | 19 (100) |
| Other types ($n$ = 20) | |
| Upper lung zone | 6 (30) |
| Middle lung zone | 2 (10) |
| Lower lung zone | 12 (60) |

The relationship between patterns of chest radiographs and duration of hospitalization, values of CRP, and patient age are summarized in Table 4. The presence of lobar–segmental consolidation was associated with the highest level of CRP, and peribronchial and perivascular interstitial infiltrates with the lowest level of CRP ($P < 0.05$). Children with lobar–segmental consolidation also had the longest duration of hospitalization. No age difference was noted between these patterns.

The relationships between pleural effusion–lymphadenopathy and duration of hospitalization, values of CRP, and patient age are summarized in Tables 5,6. When pleural effusion was noted, there was a longer duration of hospitalization and a higher level of CRP ($P < 0.05$). The presence of lymphadenopathy was not associated with the duration of hospitalization or CRP level.

## Discussion

Mycoplasma pneumonia may cause up to 35% of all cases of outpatient pneumonia and 3–18% of pneumonia cases necessitating hospitalization.[10] A longitudinal study found that the rate

**Table 4** Relationship between chest radiograph pattern and duration of hospitalization, CRP level and patient age

| Radiograph pattern | Peribronchial/perivascular interstitial ($n$ = 19) | Air-space consolidation | | Reticulonodular ($n$ = 3) | Nodular or mass-like ($n$ = 2) | $P$ |
|---|---|---|---|---|---|---|
| | | Subsegmental ($n$ = 9) | Lobar–segmental ($n$ = 6) | | | |
| Days† | 4.4 ± 2.4 | 5.2 ± 3.1 | 7.5 ± 5.7 | 4 ± 2.0 | 5.5 ± 0.7 | 0.329 |
| CRP | 1.5 ± 2.1 | 3.4 ± 5.2 | 10.6 ± 10.4 | 2.8 ± 2.0 | 5.0 ± 4.1 | 0.015 |
| Age | 5.9 | 6.7 | 7.3 | 7.7 | 5.5 | 0.571 |

†Duration of hospitalization. CRP, C-reactive protein.

**Table 5** Relationship between pleural effusion and duration of hospitalization, CRP level and patient age

| | Pleural effusion | | $P$ |
|---|---|---|---|
| | Present ($n$ = 9) | Absent ($n$ = 30) | |
| Days† | 7.4 ± 5.0 | 4 ± 2.1 | 0.010 |
| CRP | 7.7 ± 9.4 | 2.5 ± 3.5 | 0.016 |
| Age | 7.7 | 6.1 | 0.097 |

†Duration of hospitalization. CRP, C-reactive protein.

**Table 6** Relationship between lymphadenopathy and duration of hospitalization, CRP level and patient age

| | Lymphadenopathy | | $P$ |
|---|---|---|---|
| | Positive ($n$ = 5) | Negative ($n$ = 34) | |
| Days† | 3.8 ± 1.3 | 5 ± 3.4 | 0.350 |
| CRP | 4.0 ± 3.6 | 3.7 ± 6.1 | 0.919 |
| Age | 6.2 | 6.5 | 0.810 |

†Duration of hospitalization. CRP, C-reactive protein.

of endemic mycoplasma pneumonia was highest in children 5–9 years of age (4/1000 per year); the next highest rate was in children 10–14 years of age (3/1000 per year).[11]

Mycoplasma pneumonia can result in a wide spectrum of symptoms ranging from a classic presentation with fever, cough, and sputum production to more subtle and non-specific manifestations such as fatigue, malaise, and myalgia.[12] The most common symptoms and signs of mycoplasma pneumonia in the lower respiratory tract are fever (96–100%), cough (93–100%), and rales (80–84%).[13] Although the protean manifestations of mycoplasma pneumonia have been well-recognized,[14] extrapulmonary complications such as central nervous system, cardiovascular, renal, and hematologic involvement were not encountered in the present patients.

In the present study three patients were considered to have mixed bacterial infections. In patients with severe leukocytosis (>20 000/mm$^3$), extensive pulmonary infiltration, old age, and poor response to initial antibiotic therapy, mixed infections should be suspected and treated accordingly.

The radiographic manifestations of mycoplasma pneumonia are related to the pathological changes, including peribronchial and perivascular interstitial infiltrates as well as alveolar space desquamation. The histopathologic features of mycoplasma pneumonia are non-specific and overlap with other infectious pulmonary processes; thus the radiographic findings in mycoplasma pneumonia are variable and no pattern is pathognomonic.[15] It is characterized by a cellular bronchiolocentric inflammatory process primarily affecting the small airways. The thickened, edematous bronchiolar wall is heavily infiltrated by a dense chronic inflammatory cell infiltrate composed of lymphocytes and plasma cells.[16]

Previous authors have described the heterogeneity of the radiographic changes, with different incidences of their patterns.[6,7,12,15] A reticulonodular pattern or nodular opacities have been considered typical by some authors,[4,5] while others stress the occurrence of confluent or patchy consolidation.[7–9] Predominant unilateral and basal distributions have been noted.[8,15] In the present study bilateral peribronchial perivascular interstitial infiltration (49%) was most commonly observed. Unilateral disease (49%) was as common as bilateral disease.

Previous reports have indicated that 5–20% of patients with mycoplasma pneumonia present with pleural effusions;[4,12] the present series (23%) had similar results. Hilar lymphadenopathy is present in 7–22% of pediatric patients with mycoplasma pneumonia.[4,12] In the present study hilar lymphadenopathy was noted in 13% of patients.

The radiographic variability can be explained by the alveolar infiltrates being an inflammatory reaction to *M. pneumoniae*, and the interstitial densities being an immunologic response.[8] The cell-mediated immunity of the host plays an important role in the development of mycoplasma pneumonia.[17] In immunocompromised patients with severe mycoplasmal infection, the chest radiographic changes are minimal or absent.[18] This could be explained by decreased immunological reactivity in these patients, and it would, therefore, support the assumption that immunological mechanisms play a pathogenic role.

The present study had a limitation. We used both IgG and IgM positivity as inclusion criteria. Although a sensitive and specific polymerase chain reaction diagnostic method has proved its usefulness in accurate and early diagnosis of mycoplasma pneumonia, it is not available at Taipei Medical University–Wan Fang Hospital.

In conclusion, the patterns of mycoplasma pneumonia on chest radiography are non-specific and variable. Bilateral peribronchial and perivascular interstitial infiltrates, followed by air-space consolidation, were frequently seen in the present pediatric patients. Both clinical and radiographic manifestations of mycoplasma pneumonia should be considered in the differential diagnosis of community-acquired pneumonias.

## References


1 Mansel JK, Rosenow EC, Smith TF, Martin JW Jr. *Mycoplasma pneumoniae* pneumonia. *Chest* 1989; **95**: 639–46.
2 Talkington DF, Thacker WL, Keller DW, Jensen JS. Diagnosis of *Mycoplasma pneumoniae* infection in autopsy and open-lung biopsy tissues by nested PCR. *J. Clin. Microbiol*. 1998; **36**: 1151–3.
3 Rosmus HH, Pare JA, Masson AM, Fraser RG. Roentgenographic patterns of acute mycoplasma and viral pneumonitis. *J. Can. Assoc. Radiol*. 1968; **19**: 74–7.
4 John SD, Ramanathan J, Swischuk LE. Spectrum of clinical and radiographic findings in pediatric mycoplasma pneumonia. *Radiographics* 2001; **21**: 121–31.
5 Ferwerda A, Moll HA, de Groot R. Respiratory tract infections by *Mycoplasma pneumoniae* in children: A review of diagnostic and therapeutic measures. *Eur. J. Pediatr*. 2001; **160**: 483–91.
6 Foy HM, Loop J, Clarke ER *et al*. Radiographic study of *Mycoplasma pneumoniae* pneumonia. *Am. Rev. Respir. Dis*. 1973; **108**: 469–74.
7 Finnegan OC, Fowles SJ, White RJ. Radiographic appearances of mycoplasma pneumonia. *Thorax* 1981; **36**: 469–72.
8 Brolin I, Wernstedt L. Radiographic appearance of mycoplasmal pneumonia. *Scand. J. Respir. Dis*. 1978; **59**: 179–89.
9 Reittner P, Muller NL, Heyneman L *et al*. *Mycoplasma pneumoniae* pneumonia: Radiographic and high-resolution CT features in 28 patients. *AJR* 2000; **174**: 37–41.
10 Lyby JP. Pneumonia caused by *Mycoplasma pneumoniae* infection. *Clin. Chest Med*. 1991; **12**: 237–44.
11 Foy HM, Cooney MK, McMahan R, Grayston JT. Viral and mycoplasmal pneumonia in a prepaid medical care group during an eight-year period. *Am. J. Epidemiol*. 1973; **97**: 93–102.
12 Guckel C, Benz-Bohm G, Widemann B. Mycoplasmal pneumonias in childhood. Roentgen features, differential diagnosis and review of literature. *Pediatr. Radiol*. 1989; **19**: 499–503.
13 Clyde WA Jr. Clinical overview of typical *Mycoplasma pneumoniae* infections. *Clin. Infect. Dis*. 1993; **17**(Suppl. 1): S32–6.
14 Murray HW, Masur H, Senterfit LB, Roberts RB. The protean manifestations of *Mycoplasma pneumoniae* infection in adults. *Am. J. Med*. 1975; **58**: 229–42.
15 Cameron DC, Borthwick RN, Philp T. The radiographic patterns of acute mycoplasma pneumonitis. *Clin. Radiol*. 1977; **28**: 173–80.
16 Connor DH, Chandler FW, Schwartz DA, Manz HJ, Lack EE. *Pathology of Infectious Diseases*, 1st edn. Appleton & Lange, Stamford, 1997.
17 Biberfeld G, Biberfeld P, Sterner G. Cell-mediated immune response following *Mycoplasma pneumoniae* infection in man. I. Lymphocyte stimulation. *Clin. Exp. Immunol*. 1974; **17**: 29–41.
18 Foy HM, Ochs H, Davis SD, Kenny GE, Luce RR. Mycoplasma pneumoniae infections in patients with immunodeficiency syndromes: Report of four cases. *J. Infect. Dis*. 1973; **127**: 388–93.