

# Evaluation of the clinical, laboratory and radiological findings of children with *Mycoplasma pneumoniae* infection

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## ABSTRACT

**Objective:** Infections due to *Mycoplasma pneumoniae* are rare in young children and frequently follow a subclinical course. The disease is mostly seen in school-age children and is responsible for 7–30% of community-acquired pneumonia in children aged 3–15 years. In this study, the clinical, laboratory, and radiological findings of patients followed up in our clinic with *Mycoplasma pneumoniae* infection were retrospectively analyzed.

**Material and Methods:** Between January 2014 and December 2015, 102 children diagnosed with *Mycoplasma pneumoniae* infection were included. The clinical, laboratory, and radiological findings of patients diagnosed with *Mycoplasma pneumoniae* infection were evaluated retrospectively.

**Results:** The ages of the subjects ranged from 1 month to 14 years, and the mean age was 6.94±3.12 years. Fifty-two (51%) patients were female and 50 (49%) were male. The most common symptoms were cough (80.4%) and fever (79.4%). C-reactive protein positivity was detected in 65.3% of the patients, and an elevated erythrocyte sedimentation rate was found in 66.7%. Rales were detected in 56.9% of the patients, prolonged expiration in 29.4%, and wheezing in 13.7%. Pneumonia was the most common diagnosis, with a rate of 74.5%.

**Conclusion:** In cases with suspected *Mycoplasma pneumoniae* infection, C-reactive protein, sedimentation rate, and chest X-ray should be evaluated for the initial work-up. Although serological assays are the most specific and sensitive tests for the diagnosis of *Mycoplasma pneumoniae* infection, polymerase chain reaction testing, which is becoming increasingly important worldwide, should be used in routine clinical practice in our country and in our hospital.

**Keywords:** Cough; *Mycoplasma pneumoniae*; pneumonia.

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# *Mycoplasma pneumoniae* enfeksiyonu geçiren çocukların klinik laboratuvar ve radyolojik bulgularının değerlendirilmesi

## ÖZET

**Amaç:** *Mycoplasma pneumoniae* enfeksiyonları küçük çocuklarda nadir görülür ve sıklıkla subklinik seyirlidir. Hastalık çoğunlukla okul çağındaki çocuklarda görülmekte olup, 3–15 yaş arası çocuklarda toplumdan kazanılmış pnömonilerin %7–30'undan sorumludur. Bu çalışmada, hastanemiz çocuk kliniğinde takip edilen *Mycoplasma pneumoniae* enfeksiyonu geçiren hastaların klinik, laboratuvar ve radyolojik bulgularının retrospektif olarak değerlendirilmesi amaçlanmıştır.

**Gereç ve Yöntemler:** Çocuk kliniğimizde Ocak 2014 ile Aralık 2015 tarihleri arasında *Mycoplasma pneumoniae* tanısı almış 102 olgu çalışma grubunu oluşturdu. *Mycoplasma pneumoniae* enfeksiyonu tanılı hastaların klinik, laboratuvar ve radyolojik bulguları retrospektif olarak değerlendirildi.

**Bulgular:** Çalışmaya alınan olguların yaşları 1 ay ile 14 yıl arasında değişmekte olup, ortalama yaş  $6.94 \pm 3.12$  yıldır. Olguların 52'si (%51) kız, 50'si (%49) erkektir. En sık başvuru şikâyetleri %80,4 ile öksürük ve %79,4 ile ateştir. Hastaların C-reaktif protein pozitifliği %65,3, sedimentasyon yüksekliği %66,7 oranlarında saptanmıştır. Hastaların %56,9'unda raller, %29,4'ünde ekspiryum uzunluğu ve %13,7'sinde wheezing tespit edilmiştir. En sık saptanan hastalığın %74,5 oranıyla pnömoni olduğu görülmüştür.

**Tartışma:** Hastalarda *Mycoplasma pneumoniae* enfeksiyonu düşünüldüğünde, ilk etapta C-reaktif protein, sedimentasyon ve akciğer grafisi tetkikleri istenmelidir. *Mycoplasma pneumoniae* enfeksiyonunun tanısında özgüllüğü ve duyarlılığı en yüksek testler serolojik testler olsa da tüm dünyada tanıda giderek önemi artan polimerase chain reaction testi, ülkemizde ve hastanemizde günlük pratikte kullanılmaya başlanmalıdır.

**Anahtar Kelimeler:** *Mycoplasma pneumoniae*; öksürük; pnömoni.

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## INTRODUCTION

Pneumonia is the leading cause of childhood mortality worldwide. According to data from the World Health Organization (WHO), each year pneumonia is diagnosed in 155 million children under the age of five, approximately 20 million of whom require hospitalization and more than 2 million die from the disease (1, 2). It is estimated that 37% of all community-acquired pneumonia cases occur in the pediatric age group. The most common causative microorganisms are respiratory viruses and *Streptococcus pneumoniae* in younger children, while in older children *S. pneumoniae* and *Mycoplasma pneumoniae* predominate (3).

*Mycoplasma pneumoniae* infections are uncommon in young children, often presenting as subclinical infections, whereas they occur more frequently in school-aged children and account for 7–30% of community-acquired pneumonias in those aged 3–15 years (4).

The prevalence of *M. pneumoniae* as an etiological agent in childhood pneumonias has been demonstrated in various studies worldwide. However, in our country, *M. pneumoniae* is not routinely investigated in the etiological evaluation of pneumonia. In particular, there are only a limited number of studies conducted in the pediatric population.

## *Mycoplasma pneumoniae*

*Mycoplasma pneumoniae* infections can occur worldwide at any time of the year; however, they most commonly cause outbreaks during the autumn and winter months. *Mycoplasma pneumoniae* is endemic in large communities, with epidemic outbreaks occurring every four to seven years. In smaller communities, infections tend to be sporadic and may lead to outbreaks at irregular intervals.

A high transmission rate through close contact has been reported in *M. pneumoniae* infections. A significant proportion of secondary cases present with lower respiratory tract infections. Transmission occurs via respiratory droplets, with an incubation period of 7–21 days. Unlike other respiratory diseases, infections caused by *M. pneumoniae* spread more slowly, both in open communities and in closed settings such as military barracks or boarding schools. Transmission from asymptomatic individuals has not been reported (5).

When the incidence of *M. pneumoniae*-related diseases is analyzed by sex, only minimal differences are observed (6). In adults, *M. pneumoniae* pneumonia has been reported more frequently in women than in men, whereas in children the incidence is higher in males (7).

The most important clinical manifestation of *M. pneumoniae* infection is pneumonia, which accounts for 10–20% of community-acquired pneumonia cases. The most commonly affected age group is 5–14 years (8). Early symptoms of the disease include fever, fatigue, and headache. Cough typically appears three to five days after these initial symptoms. In untreated patients, the clinical course varies; however, cough tends to worsen by the second week, and all symptoms gradually resolve by the third to fourth weeks. The cough, initially nonproductive, becomes progressively productive. As coughing persists, parasternal chest pain may develop, although pleuritic chest pain is rare. Other possible symptoms include chills, sore throat, hoarseness, myalgia, rash, vomiting, and diarrhea.

On physical examination, the most common auscultatory finding is dry rales. Musical rales may also be heard during expiration. Rales can persist for two weeks and may continue for a month or longer. Despite abnormal findings on chest radiography, auscultatory findings may be absent in some patients (9).

The radiological findings of *M. pneumoniae* pneumonia are nonspecific. In 75% of patients, centrally located, more radiopaque infiltrates confined to a single lobe are most commonly observed, while hilar lymphadenopathy is present in 33% of cases. Lobar pneumonia is rare. Significant pleural effusion is uncommon; however, in patients with marked pleural effusion, the disease tends to be more severe and prolonged (10).

In patients, the total leukocyte count is usually within the normal range, while the erythrocyte sedimentation rate (ESR) is elevated (11–13). Antibodies against serum cold agglutinins may be detected (14, 15). The direct Coombs test is frequently positive, and serum immunoglobulin M (IgM) levels are elevated (16, 17).

In children and adolescents, the most common presentation of *M. pneumoniae* infection is upper respiratory tract infection. Studies conducted in children with upper respiratory tract infections have detected *M. pneumoniae* in 2–5% of patients (11, 18–22). Pharyngitis and nasopharyngitis are rarely seen as major findings but frequently accompany pneumonia (10). In children with otitis media, *M. pneumoniae* has been identified serologically in 12% of cases, although it could not be cultured. Bullous myringitis may occur during the course of *M. pneumoniae* infection (18). *Mycoplasma pneumoniae* is responsible for 10–20% of acute bronchitis cases (23, 24). Approximately 5% of bronchiolitis cases are attributable to *M. pneumoniae*. It is also an important cause of bronchial asthma and recurrent wheezing episodes in asthmatic children. Wheezing may also develop during *M. pneumoniae* pneumonia (25–27).

Various serological and microbiological methods are used in the diagnosis of infections caused by *M. pneumoniae*. In lower respiratory tract infections, serum cold agglutinins are important for diagnosis, being positive at titers  $\geq 1:32$  in 50–90% of pneumonia cases (9, 14, 15, 28). For the detection of specific antibodies, methods such as immunofluorescence, precipitation, growth inhibition, indirect hemagglutination, mycoplasmacidal antibody testing, complement fixation, enzyme-linked immunosorbent assay (ELISA), adherence inhibition, radioimmunoprecipitation,

and radioimmunoassay are utilized. A high antibody titer alone ( $>1:256$ ) generally indicates a recent infection, whereas a definitive diagnosis requires a fourfold increase in titers between paired serum samples obtained five to seven days apart during the acute phase (9, 16, 17, 29). Direct antigen detection can be performed from throat swabs using the DNA-probe test, with sensitivity and specificity rates reported as 76.7% and 91.7%, respectively, in pediatric populations. Polymerase chain reaction (PCR) may also be used for rapid diagnosis (16, 30–32). However, culture of *M. pneumoniae* is slow, requiring two to three weeks for results, highlighting the need for more rapid diagnostic methods for early detection (29, 33).

In children, the differential diagnosis of *M. pneumoniae* infections should include bacterial, viral, fungal, and Chlamydia infections. Since clinical manifestations and radiological findings are often similar, factors such as the patient's immunological status, environment, age, incubation period, and season play an important role in establishing the differential diagnosis.

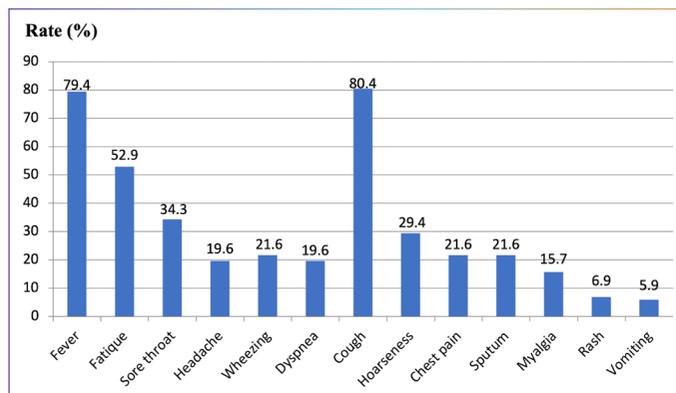
Macrolides, tetracyclines, and fluoroquinolones can be used in treatment. Although these antibiotics are not bactericidal against the pathogen, they significantly shorten the duration of illness. Pediatric studies have shown that macrolide antibiotics such as erythromycin, clarithromycin, and azithromycin are equally effective. For respiratory tract eradication, clarithromycin and azithromycin have been found to be effective in all patients (34).

Complications of *M. pneumoniae* infections are uncommon. Independent of respiratory system involvement, patients may present with manifestations affecting the central nervous system, skin, blood, heart, gastrointestinal system, and joints. Among dermatological lesions, particularly in adolescents, various exanthematous eruptions may occur, including Stevens–Johnson syndrome, maculopapular rashes, erythema nodosum, erythema multiforme, and urticaria. Neurological complications of *M. pneumoniae* include meningoencephalitis, transverse myelitis, aseptic meningitis, cerebellar ataxia, acute disseminated encephalomyelitis, and Guillain–Barré syndrome. Hematological findings associated with the disease include hemolysis, positive Coombs test, and reticulocytosis (35).

This study aimed to retrospectively evaluate the clinical presentations, laboratory results, and radiological characteristics of pediatric patients who were diagnosed with *M. pneumoniae* infection and received treatment in our clinic. In addition, the study sought to identify possible correlations between these findings and disease severity, as well as to provide a better understanding of the spectrum of *M. pneumoniae*-related manifestations in children.

## MATERIAL AND METHODS

This study retrospectively evaluated the clinical, laboratory, and radiological findings of 102 patients aged 1 month to 18 years who were diagnosed with *M. pneumoniae* infection between January 2014 and December 2015 at the Department of Pediatrics, Bakırköy Dr. Sadi Konuk Training and Research Hospital. All patients tested positive for *M. pneumoniae* IgM using ELISA.



**Figure 1.** Distribution of patients' presenting complaints.

The study was conducted in accordance with the principles of the Declaration of Helsinki and was approved by the Clinical Research Ethics Committee of Bakırköy Dr. Sadi Konuk Training and Research Hospital (Date: 2016/05/13, Decision no: 2016/05/13).

The presenting symptoms of all cases included fever, sore throat, headache, cough, hoarseness, and chest pain. Additionally, the study examined the patients' history of previous infections, prior antibiotic use, any history of asthma, and family smoking history. The evaluation also included results from complete blood counts, biochemistry tests, ESR, C-reactive protein (CRP) levels, viral serological tests, purified protein derivative (PPD) tests, and posteroanterior chest radiographs obtained during follow-up in our clinic.

## Method

### *Mycoplasma pneumoniae* IgM ELISA Test

This is a qualitative and semi-quantitative method used to detect IgM class antibodies against *M. pneumoniae* in human serum. First, 5cc of whole blood is collected into a dry tube and centrifuged to separate the serum. The patient's serum sample is diluted and simultaneously absorbed with diluted human serum containing immunoglobulin G (IgG) class antibodies to remove rheumatoid factor and prevent competitive inhibition by specific IgG. The microtiter strips are coated with *M. pneumoniae* antigens as the solid phase. The absorbed and diluted patient samples, along with ready-to-use controls, are applied to these strips. During incubation, *M. pneumoniae*-specific antibodies in positive samples and controls bind to the antigens on the strips. After washing to remove unbound serum components from the patient and control samples, horseradish peroxidase-conjugated anti-human IgM antibodies are added to the strips. Following a second incubation, binding of these anti-IgM conjugates to IgM antibodies leads to the formation of enzyme-linked immune complexes. In positive samples, after a second washing step to eliminate unbound conjugates, incubation with TMB (tetramethylbenzidine) substrate results in a blue color. This blue color changes to yellow upon

termination of the enzymatic indicator reaction with sulfuric acid. The intensity of the color is directly proportional to the amount of *M. pneumoniae*-specific IgM antibodies in the patient's serum.

## Statistical Analysis

For statistical analysis of the study findings, NCSS (Number Cruncher Statistical System) 2007 Statistical Software (NCSS LLC, Kaysville, Utah, USA) was used. In the evaluation of study data, descriptive statistical methods such as mean, standard deviation, median, frequency, and percentage were applied. For the comparison of qualitative data, the chi-square test and Fisher's exact test were used.

## RESULTS

Of the patients included in the study, 52 (51%) were female and 50 (49%) were male, with a mean age of 6.94±3.12 years. A total of 80 patients (78.5%) were aged five years and older, while 22 patients (21.5%) were younger than five years. When the distribution of cases by season was evaluated, 32.4% (n=33) presented in autumn, 16.7% (n=17) in winter, 27.5% (n=28) in spring, and 23.5% (n=24) in summer.

Of the patients, 79.4% (n=81) presented with fever, 52.9% (n=54) with fatigue, 34.3% (n=35) with sore throat, 19.6% (n=20) with headache, 21.6% (n=22) with wheezing, 19.6% (n=20) with dyspnea, 80.4% (n=82) with cough, 36.3% (n=37) with hoarseness, 29.4% (n=30) with chest pain, 21.6% (n=22) with sputum production, 15.7% (n=16) with myalgia, 6.9% (n=7) with rash, and 5.9% (n=6) with vomiting. Figure 1 illustrates the distribution of patients' presenting complaints.

On physical examination, rales were detected in 56.9% (n=58), wheezing in 13.7% (n=14), prolonged expiration in 29.4% (n=30), and cervical lymphadenitis in 6.9% (n=7) of the patients.

At admission, complete blood count, alanine aminotransferase (ALT), aspartate aminotransferase (AST), erythrocyte sedimentation rate (ESR), and CRP values were evaluated. Leukocytosis, defined as leukocyte counts (>12,000/mm<sup>3</sup>), was detected in 41.1% (n=42), while leukopenia (<4,000/mm<sup>3</sup>) was found in 1.96% (n=2) of patients. Thrombocytopenia, defined as platelet counts (<150,000/mm<sup>3</sup>), was observed in 2.9% (n=3), and thrombocytosis (>450,000/mm<sup>3</sup>) in 22.5% (n=23). Elevated AST levels (>34 U/L) were found in 31% (n=31), and elevated ALT levels (>41 U/L) in 7% (n=7) of cases. Elevated CRP levels (>0.5 mg/dL) were detected in 65.3% (n=66). Elevated ESR levels (>20 mm/h) were observed in 66.7% (n=36). The distribution of laboratory values is shown in Table 1.

In chest radiographs, infiltrations were observed in 72.5% (n=74), pleural effusion in 10.8% (n=11), and lymph node involvement in 9.8% (n=10) of the cases.

Of the patients, 19% (n=19) were treated on an outpatient basis, 50% (n=51) were hospitalized for seven days or less, and 31% (n=32) were hospitalized for more than seven days. The distribution of patients' hospital stay durations is shown in Figure 2.

**Table 1. Distribution of laboratory values**

Parameter	n	Percentage (%)
Leukocytosis (>12.000/mm <sup>3</sup> )	42	41.1
Leukopenia (<4.000/mm <sup>3</sup> )	2	1.96
Thrombocytopenia (<150.000/mm <sup>3</sup> )	3	2.9
Thrombocytosis (>450.000/mm <sup>3</sup> )	23	22.5
AST (>34 U/L)	31	31.0
ALT (>41 U/L)	7	7.0
CRP (>0.5 mg/dL)	66	65.3
ESR (>20 mm/h)	36	66.7

mm<sup>3</sup>: Cubic millimeter; U/L: Units per liter; mg/dL: Milligrams per deciliter; mm/h: Millimeters per hour; AST: Aspartate aminotransferase; ALT: Alanine aminotransferase; CRP: C-reactive protein; ESR: Erythrocyte sedimentation rate.

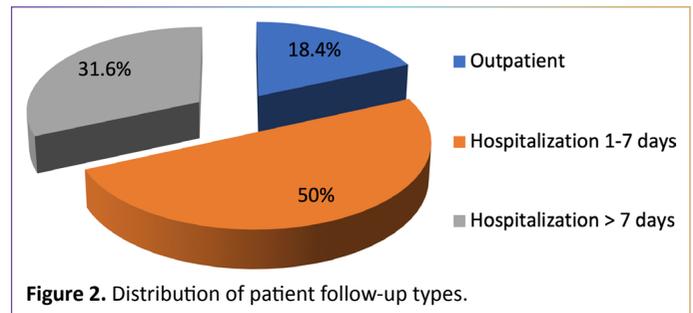
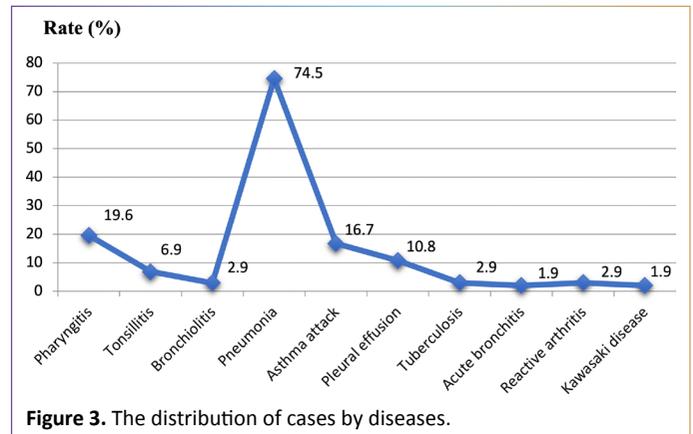
The proportion of patients with a family history of smoking was 31.4% (n=32), while a history of previous infection was present in 52% (n=53), and prior antibiotic use was reported in 97.1% (n=99). A purified PPD test was performed in 24.5% (n=25) of the patients, with two cases testing positive (>15 mm). Regarding comorbid conditions, pharyngitis was observed in 19.6% (n=20), tonsillitis in 6.9% (n=7), bronchiolitis in 2.9% (n=3), pneumonia in 74.5% (n=76), asthma attack in 16.7% (n=17), and pleural effusion in 10.8% (n=11). Less frequently, tuberculosis was detected in 2.9% (n=3), acute bronchitis in 1.9% (n=2), reactive arthritis in 2.9% (n=3), and Kawasaki disease in 1.9% (n=2). The distribution of cases by diseases is shown in Figure 3.

## DISCUSSION

According to the literature, *M. pneumoniae* IgM seropositivity is generally reported at comparable rates between sexes, although it tends to be slightly higher in females (29). In our study, the distribution of cases was similar, with 51% (n=52) females and 49% (n=50) males, which is consistent with previously published data. This finding suggests that there is no significant gender-related predisposition to *M. pneumoniae* infection.

In a study conducted in Finland in 1998, the rate of patients diagnosed with *M. pneumoniae* infection who were under five years of age was found to be 21.5% (36). Similarly, in our study, we determined that 21.5% of patients with *M. pneumoniae* infection were under five years old. In another study conducted in Denmark between 2010 and 2012, using the molecular PCR technique, 43% of 101 *M. pneumoniae* infection cases were found to be five years of age or younger. These findings suggest that with the use of molecular PCR, the number of diagnosed *M. pneumoniae* cases in children under five years has increased significantly.

When the presenting complaints at hospital admission were evaluated, cough and fever were predominant, observed in four out of every five patients. Similarly, in a study conducted by Camcıoğlu et al. (37) in Istanbul in 1995, among 20 patients with *M. pneumoniae* IgM positivity, the most frequent presenting symptoms were cough (100%) and fever (75%). Another study

**Figure 2.** Distribution of patient follow-up types.**Figure 3.** The distribution of cases by diseases.

from India in 2002 reported cough in 100% and fever in 90.1% of *M. pneumoniae* IgM-positive patients (36). Taken together, these data indicate that cough and fever are the most common presenting complaints in patients with *M. pneumoniae* IgM positivity, consistent with the findings of our study.

In the study conducted by Camcıoğlu et al. (37), CRP positivity was found in 60% of patients, elevated ESR in 70%, leukocytosis in 30%, and transient transaminase elevation in 20% (37). In a demographic study from Italy in 2008, laboratory findings of 102 patients with *Mycoplasma pneumoniae* infection were evaluated, revealing leukocytosis in 19%, CRP positivity in 77%, and thrombocytosis in 32% of cases (38). In our study, similar to these reports, CRP positivity and elevated ESR levels were observed in approximately two-thirds of the patients who underwent testing. However, no association was found with regard to leukocytosis, thrombocytosis, or elevated transaminase levels.

In the Italian study, the radiographic findings of patients with *M. pneumoniae* infection were reported as consolidation in 76.5% of cases, interstitial changes in 17%, and pleural effusion in 7.4% (38). In the study by Camcıoğlu et al. (37) pneumonic infiltration was detected in 70% of patients, hilar lymphadenopathy in 20%, and pleural effusion in 20%. In our study, chest radiographs demonstrated infiltration in 72.5% of cases, pleural effusion in 10.8%, and lymph node involvement in 9.8%.

In our cohort, the most frequently identified condition, as observed worldwide, was pneumonia, with an incidence of 74.5%. One of the main challenges clinicians face in treatment is the necessity to initiate therapy before the causative pathogen is identified. Macrolide antibiotics are the treatment of choice

for pneumonia caused by atypical agents. When the pathogen is correctly identified and the treatment duration is appropriately followed, macrolides provide an almost complete recovery. In our study, macrolides were administered to 99% of patients, either at the initiation of therapy or after *M. pneumoniae* IgM seropositivity was confirmed by serology, and all patients responded favorably to treatment.

In our cohort, the most common conditions after pneumonia were pharyngitis (19.6%), asthma attacks (16.7%), and pleural effusion (10.8%). In patients diagnosed with pharyngitis, persistence of cough and fever beyond four to five days of treatment should prompt evaluation for *M. pneumoniae* infection. In patients with asthma who are admitted due to an exacerbation, diagnostic testing for *M. pneumoniae* should be considered, as this may help to better clarify the association between *M. pneumoniae* infection and asthma attacks. Since we were unable to evaluate all patients with asthma exacerbations, our study does not provide definitive conclusions regarding this relationship. The detection of pleural effusion in 10.8% of patients is highly valuable, as all patients with *M. pneumoniae* infection underwent chest radiography.

The earlier *M. pneumoniae* infections are recognized, the easier it becomes to control pneumonia. Among the diagnostic tools, serological tests, particularly ELISA, are highly specific, sensitive, rapid, cost-effective, practical, and reliable methods that enable a definitive diagnosis. In addition, in recent years, PCR assays using nasopharyngeal and throat swab samples have become increasingly widespread worldwide, providing a very rapid, sensitive, and specific means of detecting *M. pneumoniae* DNA. Routine implementation of PCR in clinical practice in our hospital and across the country is expected to significantly increase the rate of early diagnosis and, consequently, improve the proportion of pneumonia cases that can be effectively treated.

## CONCLUSION

Based on the findings of our study, leukocyte count, CRP, ESR, and chest radiography should routinely be requested in patients with suspected *M. pneumoniae* infection.

**Ethics Committee Approval:** This study was approved by the Clinical Research Ethics Committee of the University of Bakırköy Dr. Sadi Konuk Training and Research Hospital (Date: 2016/05/13, Decision no: 2016/05/13).

**Informed Consent:** Retrospective study.

**Conflict of Interest:** No conflict of interest was declared by the authors.

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**Authorship Contributions:** Concept – TC, FKC, EES, NH; Design – TC, FKC, EES, NH; Supervision – TC, FKC, EES, NH; Resources – TC, FKC, EES, NH; Materials – TC, FKC, EES, NH; Data Collection and/or Processing – TC, FKC, EES, NH; Analysis and/or Interpretation – TC, FKC, EES, NH; Literature Search – TC, FKC, EES, NH; Writing – TC, FKC, EES, NH; Critical Reviews – TC, FKC, EES, NH.

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**Hasta Onamı:** Retrospektif çalışma.

**Çıkar Çatışması:** Yazarlar çıkar çatışması bildirmemişlerdir.

**Mali Destek:** Yazarlar bu çalışma için mali destek almadıklarını beyan etmişlerdir.

**Yazma Yardımı için Yapay Zeka Kullanımı:** Bu makale için yapay zekadan herhangi bir destek alınmamıştır.

**Yazarlık Katkıları:** Fikir – TC, FKC, EES, NH; Tasarım – TC, FKC, EES, NH; Denetlemeler – TC, FKC, EES, NH; Kaynaklar – TC, FKC, EES, NH; Malzemeler – TC, FKC, EES, NH; Veri toplanması ve/veya işleme – TC, FKC, EES, NH; Analiz ve/veya yorumlama – TC, FKC, EES, NH; Literatür araştırması – TC, FKC, EES, NH; Yazım – TC, FKC, EES, NH; Eleştirel incelemeler – TC, FKC, EES, NH.

**Hakemli inceleme:** Harici olarak hakemli.

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