과잉행동으로 발현된 *Mycoplasma pneumoniae* 감염과 관련된 뇌염 1예

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A Child with *Mycoplasma pneumoniae*-related Encephalitis Presenting as Hyperactive Behavior Change

Mycoplasma pneumoniae is a respiratory pathogen responsible for various upper and lower respiratory tract diseases. This also induces extra-pulmonary manifestations, with encephalitis being the most frequent and critical manifestation in pediatric populations. This report describes an 8-year-old boy who presented with repetitive motions in both hands, agitation, muttering and increased appetite after seizure. He had started treatment with antibiotics for *M. pneumoniae* infection 14 days prior to this event. Electroencephalography (EEG) showed slow and disorganized background rhythms and polymorphic slowing on both frontal areas, whereas brain magnetic resonance imaging was normal. He was diagnosed with *M. pneumoniae*-related encephalitis and treated with intravenous immunoglobulin (500 mg/kg/day for 4 days). After 3 days, his impulsive behaviors disappeared and, after 4 days, his EEG became normal. Abrupt hyperactive behavior in children may be a sign of *M. pneumoniae*-related encephalitis.

Key Words: *Mycoplasma pneumoniae*, Encephalitis, Hyperactive behavior, Autoimmune

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Introduction

Mycoplasma pneumoniae (*M. pneumoniae*) is the major cause of community-acquired pneumonia in children and young adults¹⁾. After the onset of respiratory illness, up to 25% of individuals infected with *M. pneumoniae* may manifest extra-pulmonary sequelae²⁾. This can affect various systems, causing neurologic, hematologic, gastrointestinal, articular and dermatologic diseases. In pediatric populations, encephalitis is the most frequent and critical neurologic manifestation³⁾.

The clinical manifestations of *M. pneumoniae*-related encephalitis are similar to those of viral encephalitis. The most frequent symptoms are fever (94%) and altered consciousness (65%), although other symptoms, including seizures, personality changes, and psychiatric symptoms, can also occur⁴⁾. However, patients representing with only behavioral changes as a main symptom of *M. pneumoniae*-related encephalitis are rare.

This report describes an 8-year-old boy who showed sudden behavioral

changes while recovering from *M. pneumoniae* infection.

Case Report

An 8-year-old boy visited the hospital with sudden explosive onset of repetitive and wiggling motions in both hands, agitation, nonstop talking while studying and playing games and increased appetite for one day after experiencing a seizure with fever. The seizure was generalized tonic clonic type lasting less than 1 minute. According to his mother, he was normally focused and quiet while studying and playing games, but the day before visiting the hospital he continuously muttered something to himself and could not remain still. Fourteen days prior to this presentation he had been treated with clarithromycin for *Mycoplasma pneumoniae* (Fig. 1), but fever did not effectively improved. Therefore methylprednisolone was prescribed as an anti-inflammatory agent for 3 days then the fever and pneumonic infiltration improved.

The patient was the older of twins. He was born via cesarean section at 30 weeks of gestation with a birth weight of 1,680 g. After initial care in the neonatal intensive care unit, he developed normally. At 15 months, he experienced a simple febrile seizure with normal growth and developmental milestones. There was

no family history of epilepsy or febrile seizure.

On admission, he was well-orientated, with normal results on neurologic examination, including tests for meningeal irritation sign and cranial nerve examination. However, he showed continuous hand movements, talkativeness, and an inability to sit still during a medical interview. Laboratory findings showed leukocytosis (WBC 13,230/mm³), but other markers, including C-reactive protein and thyroid function tests, were normal. His *M. pneumoniae* titer by particulate agglutination was 1:20,480 and his level of antistreptolysin O (ASO) was within normal limits. Cerebrospinal fluid (CSF) showed 15 cells/HPF of WBC counts and 0 cell/HPF of RBC counts. Polymerase chain reaction showed that his CSF was negative for herpes simplex viruses I and II, cytomegalovirus, human herpes virus 6, Epstein-Barr virus and enterovirus.

Electroencephalography (EEG) showed slow and disorganized background rhythms and polymorphic slowing on both frontal areas (Fig. 2A). Brain magnetic resonance imaging (MRI) yielded normal results (Fig. 3).

He was diagnosed with *M. pneumoniae*-induced encephalitis and treated with intravenous immunoglobulin (IVIG, 500 mg/kg/

Fig. 1. Chest X-ray of our patient at first admission for *Mycoplasma pneumoniae*, showing an atelectasis on the right upper lung field.

Fig. 2. (A) Electroencephalography showed slow and disorganized background activity and delta slowing in both frontal areas on admission. (B) Electroencephalography showed normal waking background activity after treatment with intravenous immunoglobulin.

day for 4 days). After 3 days of treatment, his impulsive behaviors disappeared, and after 4 days, his EEG became normal (Fig. 2B). One year after treatment, he has not experienced any recurrence.

Discussion

This report describes an 8-year-old boy who experienced a seizure and hyperactivity after *Mycoplasma pneumoniae*, but showed improvements after IVIG treatment. *M. pneumoniae* is responsible for at least 6.9% of cases of acute childhood encephalitis³. The pathophysiology underlying central nervous system manifestations of *M. pneumoniae* infection remains unclear. Complications may result from direct invasion of the brain by *M. pneumoniae*, a neurotoxin produced by the organism, or immune system-mediated damage^{5,6}. Immune-mediated injuries may be caused by cross-reacting antibodies to antigens shared by *Mycoplasma* and brain, organism-induced immunosuppression, immune complex vasculopathy, or vascular microthrombi⁷. The improvement in this patient's symptoms after IVIG administration may suggest an immune-mediated mechanism in the pathophysiology of *M. pneumoniae*-related encephalitis.

Classical clinical manifestations of *M. pneumoniae*-related encephalitis include fever, seizure, meningeal signs, ataxia, focal neurologic deficits, and altered behavior⁴. Behavioral changes of patients in previous reports were often associated with altered consciousness, ranging from minor changes to stupor or coma⁸. In one patient, *M. pneumoniae*-related encephalitis manifested as obsessive-compulsive disorder combined with changes in

MRI⁹. However the behavioral changes observed in our patient, including repetitive hand motions and anxiety, suggested hyperactivity and agitation, although he did not experience a change in consciousness or abnormalities on neurologic examination.

The distinctive changes in behavior observed in our patient may be suggested as post-ictal changes following seizure, although post-ictal changes usually last only a few minutes to hours. Post-ictal changes lasting for days are rare. Our patient had hyperactive symptoms for more than 4 days, which may be too long to be considered as post-ictal change.

The behavioral changes observed in our patient may also be side effects of steroid therapy. Two weeks prior to presentation, the patient had been treated with intravenous methylprednisolone (1 mg/kg/day) for 3 days due to refractory fever of *Mycoplasma pneumoniae*. However, the psychiatric side effects of corticosteroid treatment have a rapid onset (median, 11.5 days), with 39% of these patients experiencing onset during the first week and 62% within 2 weeks¹⁰. Another study reported that 86% of patients with psychiatric side effects developed these symptoms within 1 week of starting corticosteroid treatment¹¹. Moreover, all patients in these studies were being treated with steroids when they developed psychiatric symptoms. In contrast, the behavioral changes in our patient started after the cessation of steroid, and his EEG changes cannot be explained by the side effects of steroid therapy. Therefore the likelihood of our patient's hyperactivity being the result of steroid therapy is very low.

The differential diagnosis of acute, sudden onset psychiatric symptoms, including obsessive-compulsive disorder (OCD), tics, aggressiveness, and anxiety, is broad. These symptoms may not be psychogenic, but may be symptoms of post-infectious en-

Fig. 3. (A) Brain magnetic resonance imaging (T1-weighted image) showing normal findings. (B) Brain magnetic resonance imaging (Diffusion) showing normal findings.

cephalitis, autoimmune encephalitis, or childhood acute onset neuropsychiatric syndrome (CANS)¹²⁾. Treatment is dependent on diagnosis. Because the abrupt onset of behavioral changes in our patient, similar to attention deficit hyperactivity disorder (ADHD), was caused by *M. pneumoniae*-related encephalitis, treatment did not focus on psychiatric causes, but rather on encephalitis, resulting in symptom improvement.

In conclusion, this report describes a pediatric patient with behavioral changes following treatment for *Mycoplasma pneumoniae*, with hyperactivity being the main symptom of *M. pneumoniae*-related encephalitis. The pathophysiology behind this clinical manifestation remains unknown, but symptom improvement after IVIG therapy suggests an immune-mediated mechanism, especially autoimmune encephalitis. Overall, this case report indicates that hyperactivity in a child could be a sign of *M. pneumoniae*-induced encephalitis.

요약

Mycoplasma pneumoniae 균은 다양한 상부 또는 하부기도 감염을 일으키는 균이다. 그러나 이 균은 호흡기관 이외에 뇌염을 포함한 다양한 증상을 일으킬 수도 있다. 본 연구에서는 *M. pneumoniae* 폐렴 이후, 경련과 반복적이고 상동적인 양쪽 손의 움직임과 말더듬, 흥분불안 증상, 식욕 증가를 보인 8세 남아를 보고하고자 한다. 이 환자의 뇌파에서는 전체적인 서파, 특히 양쪽 전두엽에서 서파가 보였고, 뇌척수액 검사에서는 백혈구가 15개였으며, 뇌 MRI는 정상이었다. 따라서 이 환자는 *M. pneumoniae* 감염 후 발생한 뇌염으로 진단하였고, 정맥 감마글로블린 (500 mg/kg/day 4일간) 투여 3일 이후에 비정상적인 행동이 없어졌고, 뇌파도 정상화 되었다. 의식의 변화 없이, 갑작스러운 과잉행동 등도 뇌염의 한 증상일 수 있으므로 환자를 보는데 주의를 해야 한다.

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