Successful Treatment with Noninvasive Positive-pressure Ventilation Based on the Prediction of Disease Onset Using CT and Respiratory Function Tests in an Elderly Patient with Relapsing Polychondritis

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Abstract

An 83-year-old man who had been receiving treatment for bronchial asthma since 62 years of age experienced difficulty breathing on exertion and was admitted to the hospital. On admission, computed tomography revealed tracheal wall thickening, while test results for antinuclear antibodies and anti-type II collagen antibodies were positive. Since a saddle nose deformity, malacia of the auricles and sensorineural deafness were also observed, relapsing polychondritis was diagnosed. Measuring the peak expiratory flow rate was useful in the early airway assessment. During the follow-up period, the patient’s dyspnea worsened and noninvasive positive-pressure ventilation was introduced. As a result, the subjective symptoms improved.

Key words: relapsing polychondritis, bronchial asthma, noninvasive positive-pressure ventilation, anti-type II collagen antibody, respiratory function tests, PEFR


Introduction

Relapsing polychondritis (RP) is a chronic inflammatory disease of unknown etiology, the diagnostic criteria of which were proposed by McAdam et al. in 1976. Anti-type II collagen antibodies are often found in the sera of patients with RP, thus indicating that autoimmune abnormalities are associated with this disease (1). The mean age at onset is approximately 50 years; however, adolescent and elderly individuals (70 years of age or older) can also develop the disease (2). Since patients with RP present with expiratory wheezing and respiratory function tests that show obstructive ventilatory impairment, RP is easily misdiagnosed as asthma. Therefore, making a relatively early diagnosis of RP is difficult. Although RP is diagnosed in many patients after they receive treatment for asthma, relatively few studies have reported asthma and RP as comorbidities. A major non-pharmacological treatment of RP is tracheal stent placement, and some reports show improvement of the respiratory function with continuous positive airway pressure (CPAP) (3, 4).

We encountered an interesting case of RP in which (1) the patient had a 20-year history of asthma and developed RP at 83 years of age, (2) the patient tested positive for anti-type II collagen antibodies, (3) the onset of RP was predicted using respiratory function tests and computed tomography (CT), and the peak expiratory flow rates (PEFR) calculated from flow-volume curves were useful for early airway assessment, and (4) the introduction of bilevel positive airway pressure (PAP) therapy improved the patient’s subjective symptoms. We describe this case with a review of the relevant literature.

Case Report

The patient was an 83-year-old man who had been receiving treatment for bronchial asthma (atopic and severely persistent) since 1989. Notwithstanding good asthma control, he experienced difficulty breathing starting in December 2009. Despite increased dosages of steroids and omalizumab given to treat the asthma, the patient’s symptoms did not...
improve, and he was admitted to the hospital on November, 2010 for a detailed examination and treatment. On admission, his blood pressure was 124/76 mmHg, his heart rate was 100 beats/min, his respiratory rate was 24 breaths/min and his SpO2 was 97% on room air. A physical examination revealed a saddle nose deformity and malacia of the auricles (Fig. 1). Mild rhonchi were heard on expiration. In addition, the patient complained of tinnitus and hearing loss, and an otolaryngologist had diagnosed sensorineural deafness. Laboratory tests performed on admission revealed a 1,280-fold increase in antinuclear antibodies and positive anti-type II collagen antibodies (78.0 EU/ml). The levels of other inflammatory markers were normal. On respiratory function tests, the patient exhibited marked obstructive impairment: the forced vital capacity (FVC), PEFR and forced expiratory volume in 1 second (FEV1) had decreased since September 2009 (Fig. 2). After September 2009 when further decreases in FEV1 occurred, the lack of a reversible airway obstruction response suggested that the declined FEV1 was due to additive airway obstruction, not to worsened asthma. Chest CT performed on admission revealed tracheal and bronchial wall thickening and luminal narrowing. No airway thickening was observed on previous CT images obtained in May 2009 (Fig. 3A, B, C), although it was observed in January 2010 (Fig. 3D, E, F). Based on the imaging and facial findings, the increased levels of antinuclear antibodies and the positive test results for anti-type II collagen antibodies, RP was diagnosed. A bronchoscopic examination revealed narrowing of the tracheal lumen (Fig. 4). After admission, increased doses of steroids were administered to treat the asthma, and the patient’s dyspnea improved. Subsequently, he was discharged and followed up as an outpatient. In January 2011, his dyspnea worsened, and noninvasive positive pressure ventilation (NPPV) was introduced. With the inspiratory positive airway pressure (IPAP) set at 8 cm H2O, the expiratory positive airway pressure (EPAP) set at 4 cm H2O and the respiratory rate set at 15 breaths/min, NPPV was used at night and during the daytime when the symptoms of dyspnea appeared. Consequently, the patient’s daytime dyspnea improved, and the mean nocturnal oxygen saturation increased from 95% to 97% after the introduction of NPPV. The patient again experienced difficulty breathing in November 2011 when he developed an infection, and the NPPV settings were changed as follows: IPAP to 12 cm H2O, EPAP to 6 cm H2O and the respiratory rate to 12 breaths/min (Fig. 2). The patient’s symptoms did not subsequently worsen, and he has since been followed as an outpatient.

Discussion

The currently used diagnostic criteria for RP were initially proposed by McAdam et al. in 1976 (5) and later revised by Damiani et al. in 1979 (6). According to the criteria, obtaining histological confirmation of RP is not necessary if the patient has three or more of the following conditions: 1) bilateral auricular relapsing chondritis; 2) nasal chondritis; 3) ocular inflammation; 4) non-erosive inflammatory arthritis; 5) respiratory tract chondritis; and 6) cochlear and/or vestibular damage. Among patients with RP, 22-66% test positive for antinuclear antibodies, 16% test positive for rheumatoid factor (RF) (7-9) and approximately 30-70% test positive for autoantibodies against type II collagen, a component of cartilage (1), thus indicating that some autoimmune abnormalities are associated with the disease. Anti-type II collagen antibodies are also detected in approximately 15% of patients with chronic arthritis. However, the anti-type II collagen antibodies found in patients with RP are primarily antibodies to native type II collagen, suggesting that the antibodies themselves are directly involved in the onset of RP (1). Our patient tested positive for antinuclear antibodies and anti-type II collagen antibodies and presented with deformation of the tracheal cartilage, a saddle nose deformity, auricular deformation and sensorineural deafness, which led to the diagnosis of RP.

It has been reported that half of patients with RP present with airway lesions during the course of the disease, with 5- and 10-year survival rates of 74% and 55%, respectively (10). Airway lesions, including those that lead to respiratory failure due to airway stenosis and collapse and repeated respiratory infections, are responsible for 10-59% of deaths associated with RP (11). Therefore, airway lesions are important prognostic factors in patients with RP, and providing assessment and management of airway lesions over time is very important. Although these findings illustrate that early diagnosis and treatment are critical to the prognosis, Trentham et al. reported that the mean time from the onset of symptoms to diagnosis is 2.9 years, thus indicating that making an early diagnosis of RP is difficult (2).

The average age at onset of RP is approximately 50 years, with slightly more women being affected than men (2). Elderly individuals (70 years of age or older) are also known to develop RP. Regarding the present patient, it is particularly interesting to know whether the original diag-

Figure 1. On admission, a saddle nose deformity was observed.
Figure 2. The patient’s clinical course. EPAP: expiratory positive airway pressure, FEV₁: forced expiratory volume in 1 second, FVC: forced vital capacity, IPAP: inspiratory positive airway pressure, NPPV: noninvasive positive pressure ventilation, PEFR: peak expiratory flow rates, PSL: prednisolone.

Figure 3. Chest computed tomography (CT). No tracheal wall thickening or narrowing of the bilateral principal bronchi were observed in May 2009 (A, B, C), although they were observed in January 2010 (D, E, F).

The diagnosis of asthma was correct, and at what point in the course of his asthma did he developed RP.

Since the incidence of RP is low and patients with RP present with expiratory wheezing, many of these patients receive treatment under the diagnosis of intractable asthma or emphysema. Our patient was found to have asthma at 62 years of age, and his IgE level increased to 610 IU/mL in 1998. Reversible airway obstruction was seen in 1995 and 2005. Tests to assess airway hyperresponsiveness were not conducted in our hospital at that time. Considering these observations, it is likely that the initial diagnosis of asthma was correct.
2010. As for the respiratory function, reversibility tests per-
ever, it was observed on CT images starting in January
ing the course of the patient's asthma. No tracheal wall
tient and the results of respiratory function tests retro-
stenosis of the airways (14). CT images of the present pa-
a loss of supporting tissue caused by chondritis or cicatricial
served in RP may be due, not to loss of pulmonary elastic-
scans is characteristic of RP airway lesions (16). It has also
be reported that CT scans can identify tracheal and bron-
chial stenosis at relatively early stages of RP, in contrast to
oscopic examinations (17). Regarding the respiratory
ction, obstructive ventilatory impairment, including de-
creases in PEFR and FEV₁ on flow-volume curves, is ob-
served in patients with RP. The expiratory obstruction ob-
erved in RP may be due, not to loss of pulmonary elastic-
y, as found in chronic obstructive pulmonary disease
(COPD), but to airway collapse during expiration, owing to
a loss of supporting tissue caused by chondritis or cicatrical
stenosis of the airways (14). CT images of the present pa-
tient and the results of respiratory function tests were retro-
spectively examined to determine the time of RP onset dur-
ing the course of the patient’s asthma. No tracheal wall
thickening was observed on CT images in May 2009; how-
ever, it was observed on CT images starting in January
2010. As for the respiratory function, reversibility tests per-
formed after 2006 showed no changes in FEV₁ before or af-
ter inhalation of short-acting β₂ stimulants, and the patient
seemed to have good asthma control. After April 2010, how-
ever, inhalation of short-acting β₂ stimulants did not improve
FEV₁ to the previous levels, thus suggesting that irreversible
airway obstruction had developed since then. Moreover,
there were sharp decreases in PEFR on flow-volume curves
starting in September 2009. Based on these observations, we
can conclude that the patient likely developed RP around
September 2009, and the time to diagnosis was approximately
one year and two months after onset. Considering
the CT findings, it is possible that the tracheal wall rapidly
thickened over the course of four months. The changes in
the results of the respiratory function tests and the findings
in CT images over time indicate that PEFR measurement on
flow-volume curves may be useful for early airway assess-
ment in patients with RP. Treatment of RP often involves
medications for infections at the early stages, expectorants
and drugs to reduce airway secretions. If patients have bron-
chial asthma, emphysema or other respiratory comorbidities,
adequate treatment for the underlying disease, such as ster-
oids, is administered in addition to treatment for symp-
ptoms (18, 19). Because our patient had received Step 4 ther-
apy for severe persistent asthma (in accordance with the
Asthma Prevention and Management Guidelines) and had
taken steroids for a long time, the symptoms of saddle nose
deformity and auricular chondritis might have been relieved,
resulting in a delay in the onset of RP symptoms. For pa-
ients whose symptoms are not improved by medications,
tracheal stent placement, the major non-pharmacological
treatment, is often performed (18). Since stent placement for
benign disease may cause granulation tissue formation and
infections, the indication for the procedure should be care-
fully considered. However, the use of tracheotomy and intu-
bation may be necessary for survival in patients with signifi-
cant respiratory impairment. Several recent studies have re-
ported marked improvement of the respiratory function with
nasal CPAP (3, 4). Taking the advanced age of the patient
into consideration, we first tried to improve his respiratory
status by using a non-invasive respirator. Since the improve-
ment of airway collapse achieved with CPAP alone did not
seem to provide sufficient ventilator volume, bilevel PAP
was applied from the beginning. Consequently, the patient’s
daytime subjective symptoms and nocturnal oxygen satura-
tion improved. The pathophysiology of RP supports the idea
that maintaining positive airway pressure is effective for pre-
venting expiratory airway obstruction. Two years have
passed since the introduction of NPPV in the present case,
and no worsening of symptoms has been observed. Thus far,
the treatment has been effective; however, stent placement
would become necessary if the patient’s symptoms were to
worsen in the future.

In conclusion, although the importance of making the dif-
ferential diagnosis between RP and asthma is widely recog-
nized, it is necessary to consider the possibility of other
comorbidities in patients with intractable asthma. In addi-
tion, the present case illustrates that NPPV is effective as a
non-pharmacological treatment in elderly patients with RP.

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References
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