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IgG4-Related Disease Complicated by Brain Parenchymal Lesions Successfully Treated with Corticosteroid Therapy: A Case Report

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Immunoglobulin G4 (IgG4)-related disease (IgG4-RD) is distinguished by the infiltration of IgG4-positive plasma cells in a variety of tissues and organs including the pancreas, salivary glands, retroperitoneal lesions, kidney, and lymph nodes with elevated serum IgG4 levels. Even so, central nervous system (CNS) lesions such as brain parenchymal lesions associated with IgG4-RD are scarce. So far, only six cases of IgG4-RD in relation with brain parenchymal lesions have been described, with its characteristics still being not clear. Here we have detailed a case of IgG4-RD with brain parenchymal lesions and reviewed previously-reported cases of IgG4-RD with brain parenchymal lesions. A 62-year-old Japanese male suffering from lung silicosis was admitted to our hospital for abdominal discomfort and altered consciousness. He has shown no major neurologic abnormalities except for drowsiness, urinary retention, and fecal incontinence. Brain magnetic resonance imaging has shown scattered hyperintense signals in the brain parenchyma. The serum IgG4 levels were elevated and systemic lymph nodes were enlarged. Biopsy from inguinal lymph nodes has shown massive infiltration of IgG4-positive plasma cells: the ratio of IgG4-positive/IgG-positive plasma cells was nearly 100%. Based on clinical courses, images, laboratory data, and pathological findings, a diagnosis of IgG4-RD that was complicated by brain parenchymal lesions and sacral nerve disturbance was confirmed. The patient was then given methylprednisolone pulse therapy (1g for 3 days) succeeding oral prednisolone (1 mg per body weight). The clinical and radiological improvements together with steroid therapy proposed IgG4-RD to be the cause of the lesions.

Keywords: bladder and bowel disturbance; brain parenchyma; IgG4-related disease; lymphadenopathy; steroid therapy
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Introduction

Immunoglobulin G4 (IgG4)-related disease (IgG4-RD) is an autoimmune disorder that is distinguished using the infiltration of IgG4-positive plasma cells in a variety of tissues and organs (Kamisawa et al. 2015), which are usually accompanied with elevated serum IgG4 levels (Zen and Nakamura 2010). IgG4-RD principally affects middle-aged to elderly men and shows diffuse and/or localized swelling of organs or forming masses, ultimately resulting in organ damage (Uchida et al. 2012). The comprehensive diagnostic criteria for IgG4-RD have been suggested by Umehara et al. (2012). The features of cases with systemic IgG4-related lymphadenopathy have also been reported (Sato et al. 2009). The first-line treatment of IgG4-RD comprises glucocorticoids (Kamisawa et al. 2009), and almost all patients with IgG4-RD manifest a rapid response to glucocorticoids; however, there should be alternative diagnoses in patients who cannot show a rapid response (Brito-Zeron et al. 2016). IgG4-RD involves first and foremost the bili-

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Table 1. Laboratory Findings on Admission.

Peripheral blood		**Serological tests**	
Red blood cells	341 × $10^4/\mu$L	ANA	× 1,280 (< 160 ×)
Hemoglobin	10.5 g/dL	Anti-dsDNA Antibody	30 IU/mL (< 9.9)
Hematocrit	31.4%	Anti-Sm Antibody	2.5 U/mL (< 6.9)
Platelet	16.3 × $10^4/\mu$L	Anti-U1RNP Antibody	8.1 U/mL (< 4.9)
White blood cells	4,300/μL	Anti-SSA Antibody	0.9 U/mL (< 6.9)
Neutriphil	83.0%	Anti-SSB Antibody	1.2 U/mL (< 6.9)
Eosinophil	0.0%	Anti-PR3-ANCA	< 0.5 U/mL (0.0-2.0)
Monocyte	6.0%	Anti-MPO-ANCA	< 0.5 U/mL (0.0-3.5)
Lymphocyte	11.0%	HBs-Ag	(–)
Basophil	0.0%	HCV-Ab	(–)
Blood chemistry		HIV-Ab	(–)
Total protein	11.2 g/dL (6.6-8.1)	Tuberclosis specific interferon γ	(–)
Total bilirubin	0.4 mg/dL (0.4-1.5)	sIL-2R	959 U/mL (121-613)
Albumin	2.4 g/dL (4.1-5.1)	CEA	4.7 ng/mL (0.0-5)
Aspartate transaminase	40 IU/L (13-33)	CA19-9	13.6 U/mL (0.0-37)
Alanine aminotransferase	19 IU/L (8-42)	**Urinalysis**	
Lactate dehydrogenase	334 IU/L (260-119)	pH	6.5
Alkaline phosphatase	214 IU/L (80-250)	Specific Gravity	1.018
Creatine Kinase	57 U/L (62-287)	U-protein	(1+)
Blood urea nitrogen	13.0 mg/dL (8-20)	U-occult blood	(3+)
Creatinine	0.70 mg/dL (0.46-0.79)	U-bacterium	(–)
Na	135 mEq/L (138-145)	U-red blood cells	> 100 /HPF
K	3.3 mEq/L (3.6-4.8)	U-white blood cells	> 100 /HPF
Cl	108 mEq/L (101-108)	Hyalin cast	30 /HPF
C-reactive protein	0.29 mg/dL (< 0.30)	**Cerebrospinal fluid tests**	
Erythrocyte sedimentation rate	42 mm/hr (< 15)	Cell count	4 /μL (< 5)
Ferritin	638 ng/mL (12-60)	Protein	262 mg/dL (10-40)
IgG	6,976 mg/dL (870-1,700)	Glucose	47 mg/dL (50-75)
IgA	231 mg/dL (110-410)	Chloride	133 mmol/L (120-125)
IgM	196 mg/dL (35-220)		
IgG4	1,490 mg/dL (4.5-117)		
C3	27 mg/dL (65-135)		
C4	2 mg/dL (13-35)		

ANA, antinuclear antibodies; CA19-9, carbohydrate 19-9; CEA, carcinoembryonic antigen; HBs-Ag, hepatitis B virus surface antigen; HCV-Ab, hepatitis C virus antibody; HIV-Ab, Human Immunodeficiency Virus antibody; sIL-2R, soluble interleukin-2 receptor.

ary tree, pancreas (autoimmune pancreatitis), salivary glands, kidneys, lungs, and lymph nodes and is fewer in the central nervous system (CNS) and peripheral nervous system. In the CNS, both hypertrophic pachymeningitis (HP) and hypophysitis are the most frequent embodiment of IgG4-RD (Baptista et al. 2017); but, IgG4-RD together with brain parenchymal lesions is not common. Even though six cases of IgG4-RD that involve the brain parenchyma have already been described (Kim et al. 2011; Regev et al. 2014; Li et al. 2015; Rice et al. 2016; Tanji et al. 2016; Zhang et al. 2018), their clinical manifestations are varying, and thus, further case accumulations are compulsory for the characterization of this uncommon disease entity. We herein confer the case of IgG4-RD (IgG4-related lymphadenopathy), which is complicated by brain parenchymal lesions in a patient with modified consciousness together with urinary retention as well as bladder and bowel disturbances. Additionally, we have evaluated prior cases of IgG4-RD with brain parenchymal lesions and clarified specific clinical features as well as treatment of such cases.

Case Presentation

A 62-year-old Japanese male was admitted to our hospital having chief complaints of abdominal discomfort as well as altered consciousness. The patient had been working in a stone-crushing factory for 27 years up to the age of

48 and had been diagnosed with silicosis because of his occupational history and typical radiological manifestation in the lungs 2 years prior; the patient was followed up by a respiratory clinician. One year prior admission, the patient has noticed weight loss, and an assessment at a local hospital has shown elevated C-reactive protein (CRP), hypergammaglobulinemia, and positive serum antinuclear antibody (ANA). He was suspected to have a collagen disease and was referred to our department. His physical examination during that time indicated an enlarged right axillary lymph node and enlarged bilateral inguinal lymph nodes. Laboratory tests have shown the levels of serum IgG and IgG4 (4,280 and 791 mg/dL, respectively) to be elevated; thus, IgG4-RD was suspected. Eight months prior admission, the patient had gone through left inguinal lymph node biopsy but did not come back to our department for follow-up for 8 months until he developed abdominal discomfort.

During admission, his temperature was 38.0°C, and he was a little bit drowsy. The abdomen seemed to be distended with a tender palpable bladder. The placement of the urethral catheter has drained 700 ml of clear urine. Neurological examination has shown rectal hyposensitivity as well as diminished Achilles tendon reflex. No motor or sensory disturbance was seen in the upper or lower extremities. The laboratory tests revealed both mild normocytic anemia and liver dysfunction (Table 1); nonetheless, the serum creatine kinase level was normal. Serum CRP was normal as well, but erythrocyte sedimentation rate was elevated to 45 mm/hour. The IgG (6,976 mg/dL; normal range, 870-1,700 mg/dL) and IgG4 (1,490 mg/dL; normal range, 4.8-105 mg/dL) serum levels were also elevated. The concentration of soluble interleukin-2 receptor (sIL-2R) was 959 U/mL (normal range, 121-613 U/mL). The patient was positive for ANA (1:1,280, nucleolar and cytoplasmic patterns) and has shown weak positivity for anti-double-stranded DNA (anti-dsDNA) and anti-U1 ribonucleoprotein (U1RNP) antibodies (30 U/mL and 8.1 U/mL, respectively). Nevertheless, he was negative for anti-neutrophil cytoplasmic antibodies (ANCA) against both myeloperoxidase and proteinase 3. Bone marrow aspiration has shown a normocellular marrow with no abnormalities. Cerebrospinal fluid (CSF) examination has shown an increased protein concentration (262 mg/dL) with no pleocytosis, and there were no infectious agents identified. The IgG4 levels in the CSF were not significantly elevated in comparison to the serum concentration (CSF IgG4, 0.244 mg/mL, and serum IgG4, 1,490 mg/dL, respectively). Both T2-weighted and fluid-attenuated inversion recovery (FLAIR) brain magnetic resonance imaging (MRI) have shown scattered hyperintense lesions in the insula, putamen, and thalamus (Fig. 1a, b). Chest computed tomography (CT) scan has shown small nodules with calcification in both upper and posterior fields, enlarged hilar and mediastinal lymph nodes with calcification, and enlarged bilateral axillary lymph nodes. Abdominal CT scan has shown enlarged bilateral inguinal lymph nodes with no enlarged prostate or tumor around the urethra. ^{18}F-fluorodeoxyglucose-positron emission tomography has shown an intense uptake in bilateral axillary, hilar, mediastinal, and inguinal lymph nodes. The lung nodules were identified as silicosis (Fig. 2a-f). Histopathological examination of the left inguinal lymph node has shown massive infiltration of lymphocytes and plasma cells with interlobular expansion, suggesting a Castleman's disease-like morphology (Sato et al. 2009). Immunohistochemistry has shown that there were 125 IgG4-positive plasma cells per high-power field and that the ratio of IgG4-positive/IgG-positive plasma cells was nearly 100% (Fig. 3 a-d). Pathologic examination did not show any noncaseating granulomas. Even though fibrosis was scant, it was eventually diagnosed as IgG4-related lymphadenopathy based on the clinical course, images, and laboratory and pathological findings.

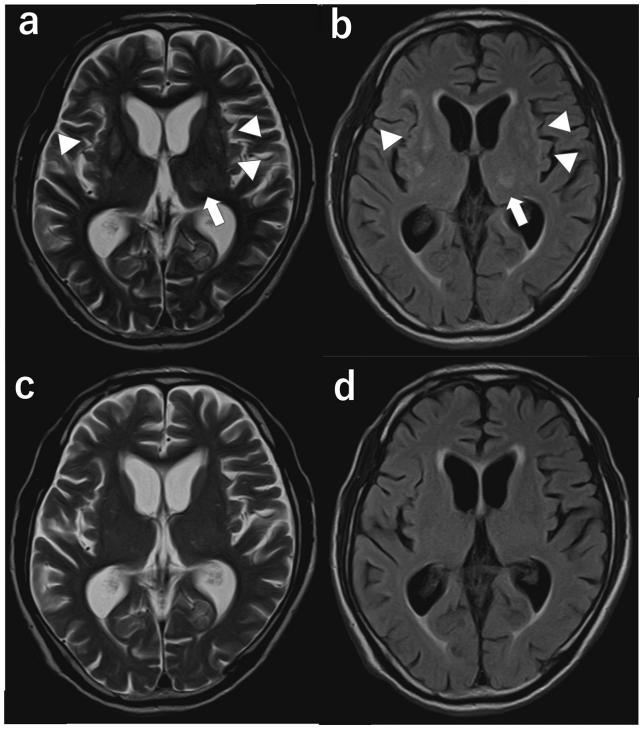

Fig. 1. Brain magnetic resonance imaging findings of the current patient.
Scattered hyperintense lesions in the left hypothalamus (arrow), bilateral insula, and putamen (arrowheads) are noted on T2-weighted (a) and fluid-attenuated inversion recovery (FLAIR) (b) MRI images prior treatment. There is marked improvement 1 month succeeding steroid administration on T2-weighted (c) and FLAIR (d) MRI images.

The clinical course of the patient is shown in Fig. 4. The patient received steroid pulse therapy (1,000 mg/day intravenous methylprednisolone) for 3 days, which is followed by oral prednisolone (1.0 mg/kg/day). Succeeding steroid pulse therapy, his fever was gone, and altered consciousness improved steadily. Succeeding brain MRI 1 month after the steroid therapy initiation has shown a complete disappearance of the hyperintense lesions in the

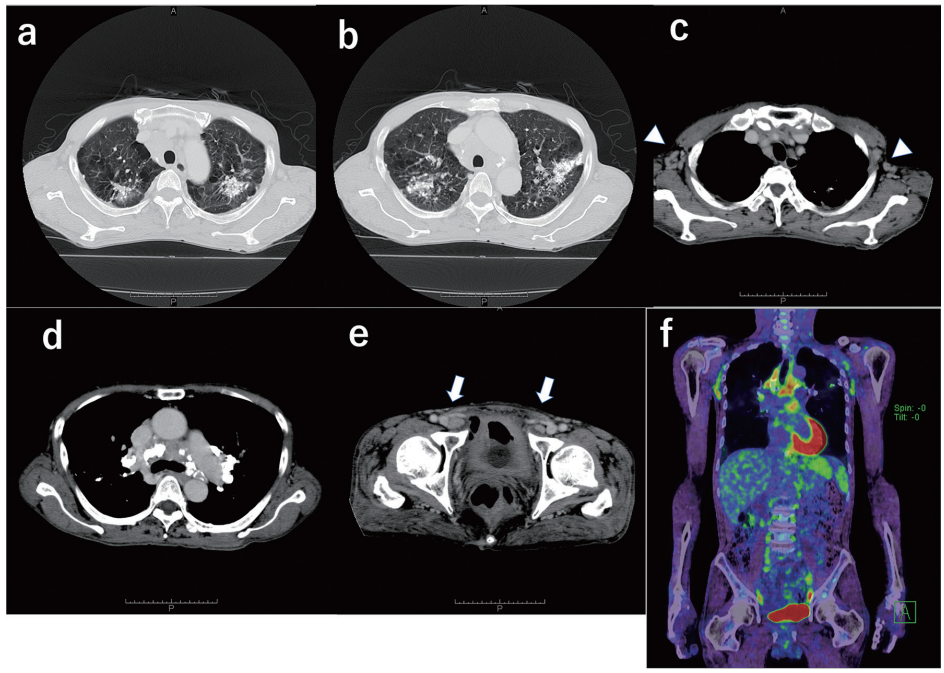

Fig. 2. Chest and abdominal computed tomography (CT) scan and ^{18}F-fluorodeoxyglucose (^{18}F-FDG)-positron emission tomography (PET) findings of the current patient.
Chest CT scan has shown small nodules with calcification in upper and posterior fields (a, b), enlarged bilateral axillary lymph nodes (arrowheads) (c), and enlarged hilar and mediastinal lymph nodes with calcification (d). Abdominal CT scan shows bilateral inguinal lymph nodes (arrows) with no prostate enlargement or tumor around the ureter (e). ^{18}F-FDG-PET reveals an increased uptake in bilateral axillary, hilar, mediastinal, and inguinal lymph nodes as well as lung nodules which are diagnosed as silicosis (f).

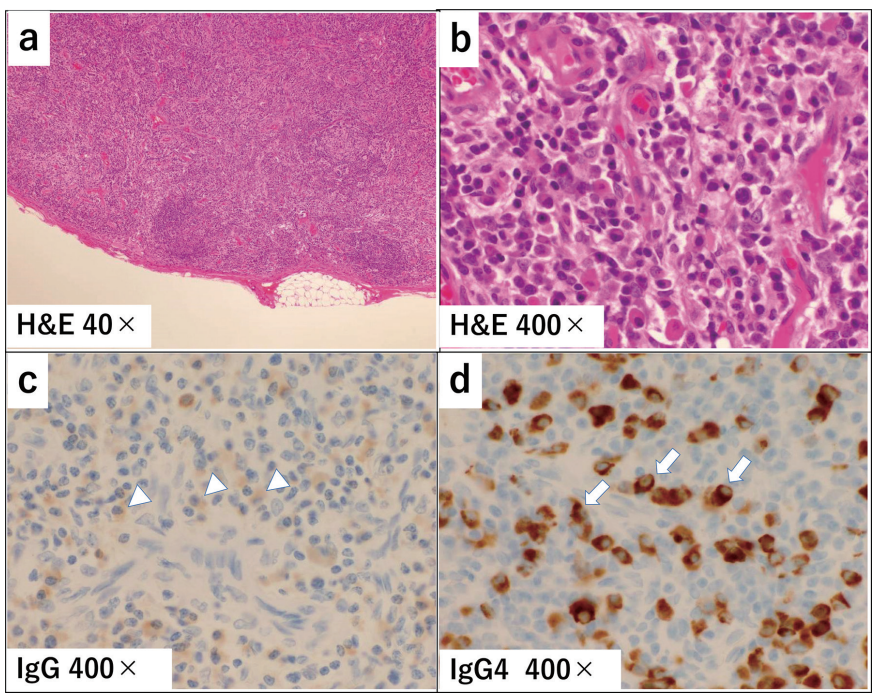

Fig. 3. Histopathological findings of the left inguinal lymph node biopsy tissue in the current patient.
Sections were stained with the following: (a, b) hematoxylin and eosin (H&E) staining (a, 40 ×; b, 400 ×), (c) immunohistochemistry for IgG (400 ×), and (d) immunohistochemistry for IgG4 (400 ×). The specimens have exhibited lymphocyte and plasma cell infiltration with interlobular expansion, suggesting Castleman's disease-like features (a, b). Most of the plasma cells are IgG-positive (arrowheads) (c), and there are approximately 125 IgG4-positive plasma cells per high-power field (arrows) with nearly 100% of the IgG/IgG4 ratio (d). These findings show that this case had IgG4-related lymphadenopathy.

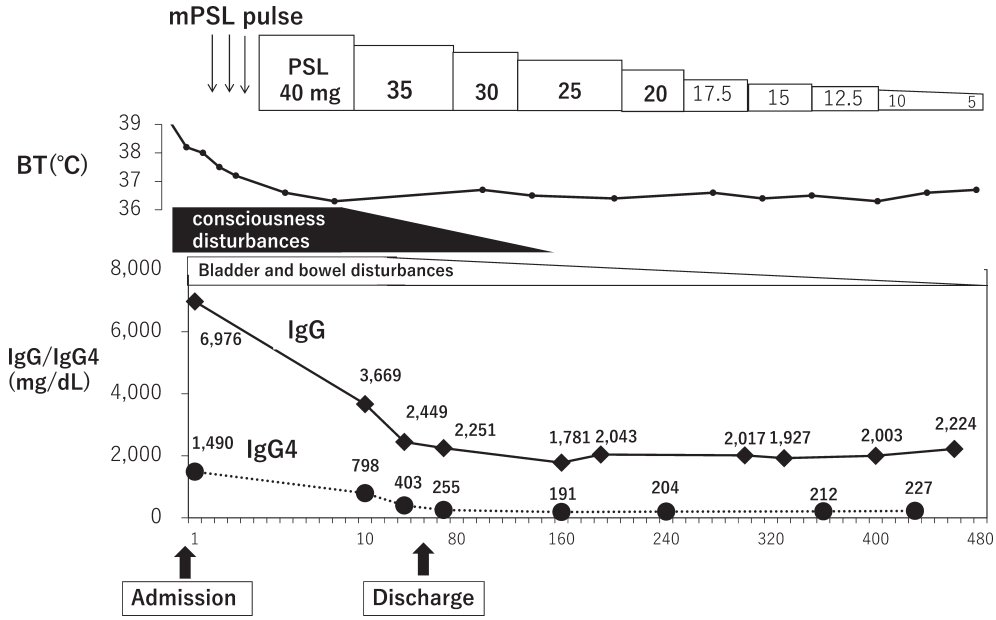

Fig. 4. Clinical course of the patient.
After the administration of corticosteroids, his symptoms (fever and altered consciousness) slowly improved according to the decrease of IgG and IgG4 levels. However, slight bladder and bowel disturbances were still there.
BT, body temperature; IgG, immunoglobulin G; mPSL, methylprednisolone; PSL, prednisolone.

insula, putamen, and thalamus (Fig. 1c, d). Lumbar MRI succeeding the initiation of steroid administration has indicated no obvious hyperintense lesions in the spinal cord. The urinary balloon catheter was separated on day 22. Nonetheless, bladder cystometry has shown low bladder compliance, indicating neurogenic disturbance of the sacral nerve upon consultation to the neurologist. Oral prednisolone dose was successfully tapered to 5 mg/day with no exacerbation of symptoms; however, there were still slight bladder and bowel disturbances.

Informed consent was acquired from the patient. Due to a case report of a single patient, ethical approval was relinquished for the institutional review board in Fukushima Medical University.

Discussion

Herein a rare case of IgG4-RD that involves brain parenchyma with sacral nerve disturbance, which was remarkably improved by steroid therapy, was introduced. Brain parenchymal lesions that have a relationship with IgG4-RD are an infrequent presentation. The review of the literature has disclosed only seven cases of brain parenchymal lesions that have a relationship with IgG4-RD with or without HP, such as our case (Kim et al. 2011; Regev et al. 2014; Li et al. 2015; Rice et al. 2016; Tanji et al. 2016; Zhang et al. 2018). The brain parenchymal lesions that have a relationship with IgG4-RD have no HP in only four of these cases (Table 2) (Regev et al. 2014; Tanji et al. 2016; Zhang et al. 2018). Our review of the cases has shown that five of the seven cases were male and that the age ranged from 29 to 62 years. All of the seven patients have shown neurological symptoms, such as hemiparesis (n = 4), headache, (n = 3), dementia (n = 2), bladder and bowel disturbance (n = 1), altered consciousness (n = 1), diplopia (n = 1), facial numbness (n = 1), hemimyoclonus (n = 1), sensory aphasia (n = 1), and visual field defect (n = 1). All IgG4-RD patients suffering from HP (3 cases) have shown isolated parenchymal lesions with normal serum IgG4 levels; on the other hand, IgG4-RD patients that are not suffering from HP (4 cases) have shown widespread parenchymal lesions with an elevated serum IgG4 and consciousness disturbances such as dementia. All four IgG4-RD cases with no HP had extracranial involvement, but not in patients suffering from HP. All the patients had glucocorticoid therapy with or without immunosuppressants such as rituximab (n = 1) and cyclophosphamide (n = 1), which resulted in a remarkable improvement of clinical manifestations and imaging findings. One patient has had surgery, which is followed by glucocorticoid treatment, resulting in a remarkable improvement (Kim et al. 2011). Brain biopsies were acquired in the six cases, and five patients met the diagnostic criteria of IgG4-RD, whereas Tanji et al. (2016) have detailed a case of inflammatory pseudotumor of the brain parenchyma with IgG4 hypergammaglobulinemia. The brain biopsy specimen has no adequate number of IgG4-positive plasma cells; however, they have concluded that the brain parenchymal lesion in their patient has a relation with IgG4-RD because of the elevated serum IgG4 level and the presence of sclerosing cholangitis as a medical comorbidity in addition to the remarkable improvement after steroid therapy. In the current case, a brain biopsy was not done because of the relatively small size of the cerebral lesions; nonetheless, the lymph node biopsy specimens have vividly designated

Table 2. Summary of patients showing IgG4-related brain parenchymal lesions reported in the English literature.

Author Years	Age/Sex	Serum IgG4	CSF IgG4	Symptoms	Isolated/widespread (affected site)	HP	Other involving organs	Brain biopsy	Treatment	Outcome
Kim 2011	43/M	Not elevated	No remark	Headache right upper extremity weakness	Isolated (left frontal lobe)	+	-	+	Surgery, followed by prednisolone	Improved
Regev 2014	50/M	Elevated (411 mg/dL)	Not elevated	Left hemiparesis hemi-myoclonus dementia	Widespread (bilateral periventricular lesions, right dorsal frontal lobe)	–	Pancreas bile ducts salivary glands	+	Corticosteroids rituximab	Improved
Li 2015	58/F	Not elevated	No remark	Left lower limb weakness	Isolated (right frontal lobe)	+	-	+	Dexamethasone	Improved
Spencer 2016	46/M	No remark	No remark	Headache right facial numbness diplopia	Isolated (right temporal lobe)	+	-	+	Prednisolone	Improved
Tanji 2016	58/F	Elevated (261 mg/dL)	No remark	Sensory aphasia right hemiparesis	Widespread (left internal capsule, left cerebral peduncle)	–	Sclerosing cholangitis	+	Corticosteroids	Improved
Zhang 2018	29/M	Elevated (3,040 mg/dL)	No remark	Visual field defect dementia headache	Widespread (left temporal lobe, left parietal lobe)	–	Autoimmune hepatitis	+	Corticosteroid cyclophosphamide	Improved
Our case 2020	62/M	Elevated (1,490 mg/dL)	Not elevated	Consciousness disturbances urinary retention bowel disturbance	Widespread (insula, putamen, thalamus)	–	Bilateral axillary and inguinal lymph nodes	–	Corticosteroids methylprednisolone pulse therapy	Improved

CSF, cerebrospinal fluid; F, female; HP, hypertrophic pachymeningitis; M, male.

IgG4-related lymphadenopathy, showing a Castleman's disease-like feature (Sato et al. 2009; Umehara et al. 2012). The presence of both IgG4-related lymphadenopathy and the remarkable clinical and radiological responses with the serum IgG4 level decrease after steroid therapy remarkably supported the diagnosis of IgG4-RD that is related to the brain parenchymal lesions. Other diseases that involve the CNS, including ANCA-associated vasculitis, lymphoma, sarcoidosis, and autoimmune autonomic ganglionopathy, were not included in the differential diagnosis because of the lack of related laboratory findings and specific or systemic clinical symptoms, whereas neuropsychiatric-systemic lupus erythematosus (NP-SLE) could be considered in this case for immunological abnormalities upon admission (hypocomplementemia, anti-ds DNA antibody-positive and ANA positive), in accordance to the SLE criteria proposed by the American College of Rheumatology in 2012 (Petri et al. 2012). Several cases of IgG4-RD that are complicated by definite SLE have already been described (Arai et al. 2018; Naramala et al. 2019). Nevertheless, symptoms indicating SLE were poor in our case in comparison to prior cases, including pleuritis and renal dysfunction. NP-SLE is considered a severe symptom that is often refractory because of the complexity of the disease and needs a strong immunosuppressive therapy (such as cyclophosphamide) to avoid poor prognosis (Zirkzee et al. 2014; Magro-Checa et al. 2016; Sato et al. 2020). Even though the complication with NP-SLE may be examined, a quick improvement of neurological symptoms as shown in the decrease of serum IgG4 levels with no immunosuppressive agents shows CNS lesions to be consequences of IgG4-RD instead of NP-SLE. Indeed, serum complement levels (C3 and C4) and anti-ds DNA levels as well were back to normal after a treatment of 6 months with no immunosuppressants, and so far, there has been no relapse. Additionally, hypocomplementemia can be regularly seen in IgG4-RD patients; for example, Muraki et al. have reported that 36% of patients suffering from autoimmune pancreatitis, a form of IgG4-RD of the pancreas, had hypocomplementemia (Muraki et al. 2006; Sugimoto et al. 2016).

The pathogenesis of IgG4-RD in the CNS is still not clear. CD4 (cluster of differentiation 4)-positive cytotoxic T lymphocytes in IgG4-RD-associated lesions are to be maintained by antigen-presenting B cells or B cell-dependent growth factors, self-perpetuating an immune response against specific microbial antigens, environmental antigens, or auto-antigens (Baptista et al. 2017), while there may be a difference between the mechanism of isolated intracranial IgG4-RD and that of IgG4-RD with extensive brain parenchymal lesions. Indeed, Regev et al. have indicated that the brain biopsy specimen from parenchymal lesions has shown prominent IgG4-positive cells that infiltrated the brain parenchyma with no increase of CSF IgG4 levels (Regev et al. 2014); these clinical features have been also spotted in the present case. Elseways, Della-Torre et al. have indicated that all patients that have IgG4-related HP (localized) in their study manifested high CSF IgG4 levels without serum IgG4 elevation (Della-Torre et al. 2013, 2014). They also proposed the use of evaluating CSF IgG4 concentrations in differentiating IgG4-related HP from other disorders, causing HP. These prior findings are uniform with the hypothesis that patients with isolated intracranial IgG4-RD show an inflammatory reaction that is compartmentalized within the intrathecal space (AbdelRazek et al. 2018).

Contrarily, the distinct pathogenesis of widespread brain parenchymal lesions in IgG4-RD was chiefly unknown: the different patterns of serum IgG4 levels as well as symptoms (elevated serum IgG4 levels and consciousness disturbances) compared with isolated IgG4-RD (normal serum IgG4 and pachymeningitis) may be a clue to understand their pathogenic mechanism.

The current patient has developed abdominal discomfort because of urinary retention, following bladder and bowel disturbance, in addition to consciousness disturbance. Generally, it is thought that urinary function is managed by the sacral spinal cord and micturition is orchestrated by the brain (Kitta et al. 2015), and it is also thought that urinary retention could happen succeeding cerebral stroke, which particularly involved the insula (Umemura et al. 2016). A patient with IgG4-RD that involves the spinal cord, which can potentially present as urinary retention, has also been detailed (Williams et al. 2017). IgG4-RD lesions in both brain parenchymal lesions and peripheral nerve can give rise to urinary symptoms; however, our case has shown slight, scattered brain parenchymal lesions, and no lesions were found in the spinal cord. Succeeding steroid therapy, there were no ischemic changes in the brain including the insula. It is therefore not clear whether urinary symptoms were conclusively because of the brain parenchymal lesions, although they cause consciousness disturbances. One study has reported the presence of IgG4-RD-related lesions in peripheral nerves; however, very few studies have described IgG4-RD neuropathy (Baptista et al. 2017), and distinct pathogenesis remains unknown. In any case, further study is needed for the clarification of the pathological mechanisms of peripheral neuropathy, which are developed in patients with IgG4-RD.

Silicosis is a fibrotic lung disease that is caused by inhalation of free crystalline silicon dioxide or silica which has a relationship with the production of autoantibodies, including ANA (Leung et al. 2012), rheumatoid factor, anti-dsDNA, and anti-U1RNP antibodies, and the development of several autoimmune diseases such as systemic lupus erythematosus, rheumatoid arthritis, systemic sclerosis, and ANCA-associated vasculitis (Doll et al. 1981; Conrad and Mehlhorn 2000; Miller et al. 2012). A patient suffering from IgG4-related autoimmune pancreatitis complicated by interstitial lung disease because of silicosis was described (Yosha et al. 2016), suggesting immunological mechanisms underlying silicosis. Nonetheless, the relationship between silicosis and IgG4-RD is not yet firmly established. Further studies are thus essential to determine whether the exposure to silica is a risk factor for IgG4-RD development.

In closing, we herein have shown the case of a patient with IgG4-RD and large-scale brain parenchymal lesions with sacral nerve disturbance which has improved succeeding steroid therapy. Brain involvement of IgG4-RD should therefore be considered in patients with elevated serum IgG and IgG4 levels, accompanying brain parenchymal lesions as well as systemic symptoms. Differences in serum IgG4 elevation pattern between IgG4-RD patients that have brain parenchymal lesions and those with localized accompanying HP might specify the distinct pathogenesis of both lesions. Immunosuppressive treatment (corticosteroids and cyclophosphamide or rituximab) is effective in both CNS lesions. Further accumulation of such cases is required for the clarification of the clinical and radiological features as well as the treatment and diagnostic strategies for IgG4-related brain parenchymal lesions.

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Conflict of Interest

The authors declare no conflict of interest.

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