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BROWN-SÉQUARD SYNDROME AFTER HERPES ZOSTER

The Brown-Séquard syndrome (BSS) is characterized by ipsilateral spastic weakness and decreased proprioceptive and vibratory sensation below the level of the lesion, and contralateral loss of pain and temperature below the level of the lesion. BSS is typically caused by injury, neoplasm, multiple sclerosis, or spinal cord infarction. BSS after vaccination for diphtheria and tetanus has also been described,¹ with additional mild spastic weakness on the side opposite the lesion indicating involvement of the contralateral pyramidal tract. Moreover, a case of BSS after infection with *Borrelia burgdorferi* responded to antibiotic treatment.² Until now, the only association of virus infection with BSS is brief mention of an incomplete BSS (weak left leg with an extensor response and decreased sensation over the right leg) after T12-distribution zoster³ and features of BSS with varicella zoster virus (VZV) meningoencephalomyelitis and vasculitis.⁴ Here we report a case of BSS after reactivation of VZV.

Case report. A 33-year-old immunocompetent man experienced malaise, nasal congestion, and bifrontal headache, followed by sharp pain over the left ear, cheek, and eye. A few days later, headache worsened, blisters developed in the left ear, and he was treated with oral acyclovir 800 mg five times daily for 4 days. Two days later, he noted numbness and tingling over the left cheek, arm, and trunk, followed by left-sided numbness and weakness. Despite retreatment by an emergency room physician with oral acyclovir 800 mg five times daily for 10 days, left-sided weakness progressed. He was started on oral prednisone 60 mg daily, tapered over 10 days. He developed left posterior neck pain and headache localized over the left eye. Paresthesias and pain developed in his right hand and leg, and his left leg became stiff. An examiner found spasticity in both legs. Brain, cervical, and thoracic MRIs were normal. The patient was immediately treated with IV acyclovir, 850 mg every 8 hours for 14 days. CSF contained 12 leukocytes, all mononuclear; CSF protein was 48 mg/dL and glucose 45 mg/dL with serum glucose of 85. Neurologic examination revealed a spastic paraparesis with clo-

nus, greater on the left, left-sided loss of vibration and position sense to C6, and right-sided loss of pain and temperature to T9. Deep tendon reflexes were brisk bilaterally, and plantar responses were equivocal. Normal laboratory data included double-stranded DNA, RNP, sn-RNP, SSA/Ro immunoglobulin G (IgG), SSB/La, C3, C4, rheumatoid factor, antiphospholipid panel, homocysteine, NMO, Lyme and mycoplasma antibody, ACE, Venereal Disease Research Laboratory, cytomegalovirus PCR, erythrocyte sedimentation rate, B12, and hepatitis panels. Antinuclear antibodies were elevated at 30 (<7.5) with a speckled pattern.

Three days later, cervical spine MRI showed a T2 hyperintense enhancing lesion at C2-3 (figure). Repeat CSF examination 2 days later revealed 1,300 erythrocytes and 21 leukocytes, 80% mononuclear; CSF protein was 53, glucose 88 with serum glucose of 134; there were no oligoclonal bands, and IgG index was 0.67 (0.2–0.6). CSF also contained both anti-VZV IgM and -IgG antibody, but not VZV DNA, with a reduced serum/CSF IgG ratio consistent with intrathecal synthesis of VZV IgG. Six weeks after onset of disease, headache had resolved and strength was normal on the left. Spasticity, hyperreflexia, and sensory loss to T9 remained.

Discussion. After geniculate zoster, our patient developed BSS. Although zoster can produce both myelitis⁵ and spinal cord infarction, the gradual progression of myelopathy over days is more consistent with VZV myelitis than spinal cord infarction due to VZV vasculopathy. The detection of anti-VZV IgG antibody, but not VZV DNA, in CSF at the time of myelopathy parallels virologic findings in other cases of VZV myelitis and vasculopathy, emphasizing the diagnostic usefulness of detecting VZV antibody in CSF in the absence of VZV DNA, particularly since VZV myelopathy can occur without rash.⁵

The development of VZV myelopathy at a site distant from zoster indicates VZV reactivation from multiple ganglia, i.e., pain and rash in one dermatome followed by neurologic disease without rash in a different dermatome. As long as 50 years ago, the observation that many patients with zoster had pain

(A) Sagittal T2-weighted MRI shows an ovoid hyperintense lesion in the upper cervical spinal cord (arrow). The lesion enhanced with gadolinium, and diffusion-weighting demonstrated an increased diffusion signal and decreased ADC signal. (B) Axial T2-weighted MRI shows involvement of the left lateral and posterior spinal cord, with some involvement of the central gray matter (arrow).

without rash in dermatomes remote from zoster pain with rash⁶ suggested the possibility of concurrent VZV reactivation from multiple ganglia. VZV DNA was recently found in saliva of 54 patients with trigeminal, cervical, thoracic, or lumbar-distribution zoster,⁷ indicating VZV reactivation from geniculate ganglia as well as ganglia corresponding to the site of zoster.

The present report not only indicates that VZV can cause BSS, but also further illustrates simultaneous reactivation of virus from multiple ganglia, in this instance, from the geniculate ganglion with rash and from cervical ganglia without rash.

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SUPERFICIAL SIDEROSIS: SEALING THE DEFECT

Superficial siderosis (SS) of the CNS results from chronic hemorrhage into the subarachnoid space with hemosiderin deposition in the subpial layers.^{1,2}

The clinical presentation includes progressive ataxia and deafness. Some patients have a history of trauma or intradural surgery. Despite extensive investigations, a cause of bleeding is frequently elusive.

An extra-arachnoid, intraspinal, or intracranial CSF collection, often longitudinally extensive, is sometimes identified in spinal neuroimaging in SS.¹⁻⁶ A dynamic CT myelogram can identify the dural defect connecting the intrathecal space with the fluid-filled collection.⁴ The precise mechanism of bleeding is unknown. Rarely CSF hypovolemia accompanies SS.⁶ Increased CSF RBC count may be seen in CSF hypovolemia.⁷ These observations have led to the suggestion that repairing the dural defect may halt bleeding and prevent deficit progression.⁶ Clinical confirmation of this hypothesis is lacking.

We describe a patient with SS and CSF hypovolemia due to a CSF leak. Repair of the leak was accom-

panied by clinical improvement and resolution of neuroimaging and CSF abnormalities.

Case report. A 64-year-old man was evaluated for a 3-year history of progressive imbalance and 10-year history of decreased hearing. His history was remarkable for childhood poliomyelitis. Over the years he had multiple horse riding-related falls. Twenty years earlier he had a C4-C7 laminectomy for right upper limb weakness. On examination, he had mild proximal right upper limb weakness. Deficits related to his polio included mild, right greater than left, lower limb weakness and wasting. He had difficulty with the heel-shin and finger-nose tests. Upper limb rapid

Figure Brain MRI (A, B, G), spine MRI (C, D, H), and CT myelogram (E, F) before (A-F) and after (G, H) treatment

(A) Axial T2-weighted brain MRI shows hypointensity due to hemosiderin deposition along the cerebellar folia. (B) Axial T1-weighted brain MRI with contrast shows dural thickening and enhancement suggesting CSF hypovolemia. (C, D) Sagittal T2-weighted spine MRI shows a longitudinally extensive intraspinal fluid-filled cavity ventral to the cord from C3 to T11. The inset in (D) shows the cavity on an axial mid-thoracic cut. (E) Dynamic CT myelogram shows leakage of contrast (arrow); the dotted arrow points to intrathecal contrast. (F) Dynamic CT myelogram shows calcified disc protrusion immediately caudal to the dural defect shown in (E); the dotted arrow points to intrathecal contrast. (G) Axial T1-weighted MRI with contrast 6 months after surgery shows absence of dural thickening and pachymeningeal enhancement. (H) Sagittal T2-weighted thoracic spine MRI shows resolution of the intraspinal fluid-filled collection.

alternating movements were irregular. His gait was ataxic with marked difficulty on tandem gait.

Brain MRI showed cerebellar atrophy and a confluent T2-hypointensity along the cerebellar surface (figure, A). The hypointensity was typical of that seen due to hemosiderin deposition in SS. Mild dural thickening and pachymeningeal enhancement similar to that seen in CSF hypovolemia was present (figure, B). Spine MRI revealed an intraspinal fluid collection ventral to the cord from C3 to T11 (figure, C and D). Postoperative findings related to the cervical laminectomy and incidental mid-thoracic degenerative disc disease were present. Cerebral angiogram and intracranial MRA were unremarkable except for segments of luminal irregularities.

CSF study showed xanthochromia with a protein count of 65 mg/dL. CSF erythrocyte count was 462/ μ L and leukocyte count was 2 cells/ μ L. The opening pressure was reduced to 4 mm water. CT myelogram demonstrated free communication between the ventral fluid collection and thecal sac. The point of communication could not be identified because of rapid opacification of the fluid-filled space with contrast. Dynamic CT myelogram demonstrated egress of contrast (figure, E) adjacent to a calcified disc protrusion (figure, F) at T7-8.

Eight months later, a T5-7 laminectomy was done. The underlying dura was reflected to permit cord exploration. The dura, nerve roots, and cord appeared normal at this level. A dural defect or bleeding source was not identified. Free fat graft was placed in the epidural space at T7-8 and a sealant (DuraSeal) was injected into the epidural space through the lateral gutters on the right at T6-7.

At 6 months follow-up, the patient reported improvement in his balance and illustrated this by stating that he was able to resume dancing. His neurologic examination was unchanged other than slight improvement in tandem gait. A head MRI showed resolution of the dural thickening and enhancement (figure, G). The thoracic spine MRI showed resolution of the large ventral epidural CSF collection (figure, H). CSF study showed 1 leukocyte/ μ L, 1 erythrocyte/ μ L, and protein count of 56 mg/dL. The opening pressure was normal at 186 mm water.

Discussion. Some patients with SS have dural defects similar to those encountered in CSF hypovolemia syn-

dromes due to a CSF leak. Both disorders may have increase in CSF erythrocyte count and intraspinal fluid collection of variable longitudinal extent. The increased CSF erythrocyte count could be due to the intradural vascular engorgement that accompanies CSF hypotension.⁷

Our patient's postoperative clinical improvement was accompanied by resolution of abnormalities on MRI and normalization of the CSF analysis, including normalization of the opening pressure. The abnormalities related to hemosiderin deposition persisted. The mechanical (fat graft) and chemical (sealant: DuraSeal) sealing at the site of leak suggested by the CT myelogram were the likely reason for the improvement. The absence of a visible dural defect at surgery may point to the defect being small. It is also possible that the leak was intermittent and positional. The calcified disc protrusion could have caused the dural defect.

This is the only report that details the clinical outcome in SS where the dural leak associated with a longitudinal intraspinal fluid collection has been repaired.

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SYPHILITIC MYELITIS: RARE, NONSPECIFIC, BUT TREATABLE

Syphilis outbreaks have re-emerged throughout the world, particularly among homosexual men.¹ Syphilitic myelitis is a rare manifestation of syphilis and a rare cause of myelopathic syndromes in general. We report a patient with complete clinical and radiologic re-

covery following treatment. As the clinical presentation was nonspecific, only serologic testing revealed the diagnosis.

Case report. A 46-year-old man was admitted with a 7-day history of progressive genital and sacral numbness, pain in the groin, without motor or autonomic

dysfunction. Examination documented hypoalgesia and thermohypesthesia, normal sphincter tone, and pyramidal signs with hyperreflexia of the legs. Spinal MRI revealed swelling and high signal intensity of the central portion of the spinal cord parenchyma below T6 on T2-weighted images and two focal gadolinium enhancements (figure). Brain MRI was normal. CSF examination showed 113 mononuclear cells/ μL , 0.72 g/L protein, and normal glucose and lactate levels. Antinuclear antibodies, antineutrophil cytoplasmic antibodies, and rheumatic factor were negative. The *Treponema pallidum* hemagglutination test and the Venereal Disease Research Laboratory (VDRL) test were positive with 1:81,920 ($<1:80$) and 1:64 ($<1:2$). A positive intrathecal *Treponema pallidum* antibody (iTPA) index confirmed neurosyphilis. Active HIV, herpes, human T-cell lymphotropic virus, *Mycoplasma pneumoniae*, *Schistosoma*, or *Borrelia burgdorferi* infections were excluded. NMO antibodies were negative. Treatment with penicillin G (6×4 Mio IU IV for 21 days) and methylprednisolone (100 mg/day, 50 mg/day, and 12.5 mg/day for 3 days each) was initiated. Symptoms started to improve the second day of treatment. The patient reported homosexual risk behavior, but could not recall symptoms of primary or secondary syphilis. Three months later, only mild numbness of dermatomes S3-5 persisted. After 6 months, neurologic examination, CSF findings, and spinal MRI were normal.

Serum VDRL had decreased fourfold to 1:16 and the iTPA turned negative, indicating cure.

Discussion. Although approximately one-third of patients with early syphilis show treponemal invasion of the CSF, symptomatic neurosyphilis, especially syphilitic myelitis, has become extremely rare.² In the preantibiotic era, syphilis was the most frequent cause of myelopathy.³ Patients presented with sensory levels, lower extremity weakness, pyramidal signs, and variable degrees of bladder and bowel dysfunction, but also with polyradiculopathy. Pathologies have been related to meningomyelitis, meningovascular disease, and cord atrophy (tabes dorsalis), but also to cord compression from gummae or syphilitic osteitis. In our patient, clinical presentation, cord swelling, and the complete reversibility of all pathologic findings suggest meningomyelitis rather than ischemia (spinal meningovascular syphilis).

Syphilitic myelitis has to be distinguished from other causes of myelopathy such as ischemia, spinal arteriovenous malformation, postinfectious demyelination,³ or acute disseminated encephalomyelitis, which usually includes encephalopathy. MRI findings in syphilitic myelitis are infrequently reported. The high-signal lesion on T2-weighted images of the spinal cord parenchyma, confined to the central portion and extending over multiple levels, has been similarly described.⁴ The distribution of contrast enhancements located within T2 hyperintense lesions in our patient differs from previous reports observing abnormal enhancement in the superficial parts of spinal cord parenchyma (candle guttering appearance) and reversed signal intensities on T2-weighted images and gadolinium-enhanced T1-weighted images (flip-flop sign). Our observation points out that MR findings in syphilitic meningomyelitis are nonspecific and may among others mimic viral myelitides (HIV, HTLV1, herpes), accounting for 20–40% of infectious myelopathies.

CSF should be examined in patients with documented syphilis in the following settings: neurologic or ocular signs, HIV-positive individuals with late latent syphilis or syphilis of unknown duration, in tertiary syphilis, as well as in the case of treatment failure. A serum rapid plasma reagin (RPR) = 1:32 significantly increases the likelihood of neurosyphilis and may warrant CSF examination.⁵ The diagnosis of neurosyphilis requires at least one of the following CSF pathologies: 1) increased cell count or protein, 2) a reactive VDRL or RPR, 3) a positive iTPA index indicating specific intrathecal antibody production, or 4) a positive PCR for *T pallidum*.

(A) Sagittal T2-weighted image of the thoracic spinal cord shows long-segment diffuse high signal intensity affecting the central myelon from T6 through to the conus with cord swelling. (B) Sagittal T1-weighted image with contrast shows two focal enhancements T9/T10. (C) Axial T2-weighted image at T9/T10 level. (D) Axial T1-weighted image with contrast T9/T10 level.

Guidelines recommend treatment of neurosyphilis with 18–24 million units of aqueous penicillin IV per day for 10–14 days. Prednisolone may be added to prevent cord edema, ischemia, or Jarisch-Herxheimer reactions.² CSF examination should be repeated every 6 months after therapy until CSF normalization. Non-treponemal tests usually become nonreactive with time after treatment, but may persist at low titers. Treatment failure is defined as either a fourfold increase in non-treponemal titers, the failure to reach a fourfold decline of an initial titer $\geq 1:32$ within 12–24 months, or new signs or symptoms of syphilis.⁶

Because of the nonspecific manifestations (clinical, routine laboratory, CSF, MRI findings) and the curability of syphilitic myelitis, all patients with unclear myelopathy should undergo serologic testing for syphilis.

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