**Cerebellitis Associated with Influenza A(H1N1)pdm09, United States, 2013**

To the Editor: Central nervous system (CNS) manifestations of influenza are uncommon, especially in adults (1,2), and influenza-associated cerebellitis is exceedingly rare: 8 cases have been reported (3–7; online Technical Appendix). We describe a case of cerebellitis caused by influenza A(H1N1)pdm09 in an adult woman.

The 37-year-old female patient who sought medical care in Florida, United States, on January 5, 2013, described a 4-day history of intermittent fever of 38.5°C, generalized fatigue, diffuse headache, mild nonproductive cough, 3 episodes of vomiting, and decreased oral intake. On January 4, she experienced acute onset of ataxia and dysarthric speech with slurred pronunciation. She reported no contact with sick persons, recent travel, or exposure to pets or birds. She had a medical history of asthma since childhood, controlled by using montelukast tablets and inhaled steroids. The patient denied having ever received an influenza vaccination.

The patient appeared ill; her oral temperature was elevated at 38.3°C, but other vital signs were within normal limits (blood pressure 109/70 mm Hg; pulse rate 88 beats/minute; respiratory rate 15 breaths per minute; and oxygen saturation 98% at room air). Muscular membranes appeared normal. No neck stiffness or palpable lymph nodes were noted. Results of heart examination were normal. Lungs were clear and auscultation, and the abdomen was soft, indicating no hepatosplenomegaly. The patient’s medical history of asthma since childhood was noted. Results of heart examination were normal. Lungs were clear and auscultation, and the abdomen was soft, indicating no hepatosplenomegaly. The patient was afebrile on presentation.

On January 4, she experienced acute onset of ataxia and dysarthric speech with slurred pronunciation. She reported no contact with sick persons, recent travel, or exposure to pets or birds. She had a medical history of asthma since childhood, controlled by using montelukast tablets and inhaled steroids. The patient denied having ever received an influenza vaccination.

The patient appeared ill; her oral temperature was elevated at 38.3°C, but other vital signs were within normal limits (blood pressure 109/70 mm Hg; pulse rate 88 beats/minute; respiratory rate 15 breaths per minute; and oxygen saturation 98% at room air). Muscular membranes appeared normal. No neck stiffness or palpable lymph nodes were noted. Results of heart examination were normal. Lungs were clear and auscultation, and the abdomen was soft, indicating no hepatosplenomegaly. The patient was afebrile on presentation.

The patient denied having ever received an influenza vaccination.

The patient appeared ill; her oral temperature was elevated at 38.3°C, but other vital signs were within normal limits (blood pressure 109/70 mm Hg; pulse rate 88 beats/minute; respiratory rate 15 breaths per minute; and oxygen saturation 98% at room air). Muscular membranes appeared normal. No neck stiffness or palpable lymph nodes were noted. Results of heart examination were normal. Lungs were clear and auscultation, and the abdomen was soft, indicating no hepatosplenomegaly. The patient was afebrile on presentation.
negative for pathogens. A chest radiograph did not show infiltrates. Bacterial culture, acid-fast smear, and culture of CSF were all negative. Blood and CSF tests for HIV syphilis, respectively, were nonreactive. However, reverse transcription PCR (RT-PCR) for influenza A(H1N1)pdm09 virus RNA was positive in the nasopharyngeal swab sample and CSF specimens, at a titer of \( 4.5 \times 10^6 \) and 671 RNA copies/mL, respectively. RT-PCR of CSF was negative for viruses, including herpes simplex, Epstein-Barr, cytomegalovirus, West Nile, and herpes zoster.

The patient was given oseltamivir, 75 mg orally twice daily for 5 days. She experienced a progressive improvement of ataxia and dysarthria during her hospital stay and was discharged after 1 week. At a follow-up visit 2 months later, the patient had remained healthy and neurologically stable.

Cerebellitis, or acute cerebellar ataxia, is an inflammatory process of the cerebellar white matter that occasionally is manifested after systemic viral or bacterial infections (8). The following pathogens are known to cause acute cerebellitis: viruses varicella-zoster, herpes simplex, Epstein-Barr, rotavirus, echovirus, coxsackie, mumps, measles, and rubella; and bacteria *Borrelia burgdorferi*, *Coxiella burnetii*, *Salmonella typhi*, and *Bordetella pertussis* (8). Although the condition is presumed to be more common in children, adult cases of cerebellitis have been well described (8).

Before this case, influenza cerebellitis had been diagnosed in 8 cases as of 2011 (3–7) (online Technical Appendix Table, http://wwwnc.cdc.gov/EID/article/20/9/14-0160-Techapp1.pdf). Two cases were reported in adult women and the remaining were in children. Four had a probable diagnosis of influenza cerebellitis, although positive viral culture or RT-PCR was lacking (4). Seven case-patients had influenza-like illness preceding the neurologic symptoms (3–6). One case-patient showed evidence of pneumonia, and described the interval from respiratory illness onset to developing of cerebellar signs (6) Clinical sequelae, displayed in most case-patients affected by influenza cerebellitis (3,4,6,7), varied from complete recovery to development of serious complications such as hydrocephalus (5).

The pathogenic mechanism of influenza virus infection on the CNS can be either a direct invasion of the virus that causes acute illness or, more typically, a delayed autoimmune demyelinating postviral encephalopathy (9,10). Amplification of viral DNA in CSF is rare in most influenza-related CNS infections (10). In this case, the positive RT-PCR results for influenza A and the pertinent brain MRI findings, as well as the concurrent influenza prodromal symptoms, suggest that acute influenza cerebellitis, rather than a postinfluenza encephalopathy, caused the associated neurologic findings.

The limitation of this report includes the lack of sequence data comparing the patient’s viral RNA from the CSF and the nasopharynx and the absence of sequential sampling during the course of her illness. In conclusion, influenza virus, though rare, should remain a consideration in patients who have acute cerebellitis during influenza season.
Acknowledgments
We thank Lesley K. of the University of Miami Writing Center staff for the help in crafting the revised manuscript.

Maroun M. Sfeir and Catherine E. Najem
Author affiliations: University of Miami Miller School of Medicine/Jackson Memorial Hospital, Miami, Florida, USA (M.F. Sfeir); and Roger Williams Medical Center, Providence, Rhode Island, USA (C.E. Najem)

DOI: http://dx.doi.org/10.3201/eid2009.140160

References


Address for correspondence: Maroun M. Sfeir, Department of Medicine, University of Miami Miller School of Medicine/Jackson Memorial Hospital, 1611 NW 12th Ave, Miami, FL 33136, USA; email: mfsfeir@med.miami.edu

---

Potential Human Adaptation Mutation of Influenza A(H5N1) Virus, Canada

To the Editor: In December 2013, influenza associated with pandemic influenza A H5N1 was reported in Canada in a patient who had traveled to China; the patient died in January 2014. This case leaves unanswered questions.

In the absence of direct poultry contact by the patient, the possible route of transmission and infection, often influenced by receptor-binding properties of the virus, requires special attention. The full genome and phylogenetic analysis by Pabbaraju et al. (1) provides a summary of what can typically be deduced from the sequence. The authors also mention 2 novel mutations, R189K and G221R, in the hemagglutinin (HA) protein (R193K and G225R in H3 numbering), used to H1N1: a first case report. P0102. J Neurol Neurosurg Psychiatry. 2010;81:e53. http://dx.doi.org/10.1136/jnnp.2010.226340.143

The interaction energies of all atoms in a system are described and combined with distance-dependent functions for different interaction types, including bonds, various angles, van der Waals, electrostatics, and solvent, which leads to consideration of the concerted effects of all residues in the binding pocket. By using this energy function, short molecular dynamics simulations enable all atoms to move for specified intervals within the constraints of their interactions. These simulations are used to minimize and finally predict the energies of the wild-type and mutant HA proteins for their ligand-bound and unbound states considering their respective ligands (see Methods section of [3] for details).
Cerebellitis Associated with Influenza A(H1N1)pdm09, United States, 2013

Technical Appendix Table. Characteristics of 8 reported cases of influenza cerebellitis in 5 published articles before this study. Six of the cases were described in children. Five patients had possible diagnosis of influenza cerebellitis. One patient had a complicated course.

<table>
<thead>
<tr>
<th>Published case, year of publication</th>
<th>Characteristics, signs, symptoms</th>
<th>Brain imaging</th>
<th>CSF analysis</th>
<th>Confirmed (C) or probable (P) influenza cerebellitis</th>
<th>Lower respiratory tract symptoms and chest radiography findings</th>
<th>Treatment</th>
<th>Resolution of symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hayase Y et al, Internal Medicine 1997 (English)</td>
<td>Woman, 31 y; fever and ataxia</td>
<td>Normal brain CT and MRI</td>
<td>Normal cell count, glucose and protein</td>
<td>(C) High serum hemagglutination inhibition titer to influenza B, and positive CSF RT-PCR for influenza B nucleoprotein gene</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Tili-Graess K et al, J Neuroradiol. 2006 (French)</td>
<td>4 children, 2-7 y; headache, fever, and vomiting; ataxia was present in 2 cases</td>
<td>Initial MRI (2 cases) demonstrated increased intensity on T2W and Flair sequences of the cerebellar gray matter</td>
<td>High lymphocytes and proteins in samples from 3 children; normal values for 1 child</td>
<td>(P) Viral serologic tests were negative for 3 cases; serum sample from 1 child was positive for Epstein-Barr virus</td>
<td>No respiratory symptoms noted. No chest radiograph</td>
<td>Prednisone ×5 d for 3 cases and ×10 d for 1 case.</td>
<td>Complete resolution of symptoms in 3 cases; persistent mild right upper limb paresis in 1 case</td>
</tr>
<tr>
<td>Apok V et al, J Neurol Neurosurg Psychiatry Poster 0102,2010 (English)</td>
<td>Teenaged girl with acute fulminant cerebellitis following a course of antiviral for H1N1 virus</td>
<td>Hydrocephalus</td>
<td>NA</td>
<td>CSF samples RT-PCR-positive for influenza A and influenza B and nasopharyngeal aspirate RT-PCR-positive for influenza A(H1N1) and B.</td>
<td>2 weeks before treatment sought, patient had rhinitis, cough, and fever; chest radiography showed mild bilateral bronchial prominence</td>
<td>Oseltamivir ×5 d</td>
<td>All symptoms fully resolved after 1 week</td>
</tr>
<tr>
<td>Hackett I et al, Ir Med J. 2013 (English)</td>
<td>Child, 6 y; headache, worsening dysarthria and ataxia; coordination revealed significant bilateral dysdiadochokinesis</td>
<td>MRI brain revealed findings consistent with a diagnosis of cerebellitis, no enhancement was noted post contrast</td>
<td>Lumbar puncture parameters were normal</td>
<td>(C) Nasal swab sample positive in the influenza assay and a &gt;4x change in the antibody titer to influenza virus A</td>
<td>Not available</td>
<td>Oseltamivir</td>
<td>Truncal ataxia normalized after 3 mo.†</td>
</tr>
<tr>
<td>Ishikawa T et al, Rinsho Shinkeigaku. 2006 (Japanese)</td>
<td>Woman, 25 y; fever and headache</td>
<td>T2-weighted brain MRI demonstrated a high signal lesion in the cerebellar cortex.123I-</td>
<td>Pleocytosis</td>
<td>(C) Nasal swab sample positive in the influenza assay and a &gt;4x change in the antibody titer to influenza virus A</td>
<td>Not available</td>
<td>Oseltamivir</td>
<td>Truncal ataxia normalized after 3 mo.†</td>
</tr>
<tr>
<td>Published case, year of publication, (Language of publication)</td>
<td>Characteristics, signs, symptoms</td>
<td>Brain imaging</td>
<td>CSF analysis</td>
<td>Confirmed (C) or probable (P) influenza cerebellitis</td>
<td>Lower respiratory tract symptoms and chest radiography findings</td>
<td>Resolution of symptoms</td>
<td>Treatment</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>IMP-SPECT showed hypoperfusion in the cerebellum</td>
<td>(H3N2) detected by hemagglutination inhibition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*NA: not available.
†Followup imaging showed cerebellar cortical lesion observed on MRI had resolved 80 days after hospitalization; laboratory data indicated that cerebrospinal fluid pleocytosis had normalized ≈3 months later.