POWASSAN VIRUS DISEASE

(Powassan encephalitis, POW)

REPORTING INFORMATION

- **Class B1:** Report by the end of the next business day in which the case or suspected case presents and/or a positive laboratory result to the local public health department where the patient resides. If patient residence is unknown, report to the local public health department in which the reporting health care provider or laboratory is located.
- Reporting Form(s) and/or Mechanism:
    - Ohio Confidential Reportable Disease form (HEA 3334, rev. 1/09), Positive Laboratory Findings for Reportable Disease form (HEA 3333, rev. 8/05), the local public health department via the Ohio Disease Reporting System (ODRS) or telephone.
    - The Centers for Disease Control and Prevention (CDC) Mosquito borne Illness Case Investigation worksheet is available for use to assist in local disease investigation. Information collected from the form should be entered into ODRS and not sent to ODH, unless otherwise requested. If requested, the mailing address for this form is: Ohio Department of Health, Outbreak Response and Bioterrorism Investigation Team, 246 North High Street, Columbus, Ohio 43215.
- Additional reporting information, with specifics regarding the key fields for ODRS reporting, can be located in Section 7.

AGENT

Powassan virus is an RNA virus in the genus Flavivirus of the Flaviviridae family. There is substantial serologic cross-reaction with other flaviviruses (e.g. dengue, St. Louis encephalitis, yellow fever, Japanese B encephalitis, West Nile virus).

Infectious dose: A single bite of an infectious tick.

CASE DEFINITION

Clinical Description

Most arboviral infections are asymptomatic. Clinical disease ranges from mild febrile illness to severe encephalitis. For the purposes of surveillance and reporting, based on their clinical presentation, arboviral disease cases are often categorized into two primary groups: neuroinvasive disease and non-neuroinvasive disease.

Clinical Criteria for Diagnosis

Neuroinvasive disease: A clinically compatible case of neuroinvasive arboviral disease is defined as follows:

- Fever (≥100.4°F or 38°C) as reported by the patient or a healthcare provider and
- Meningitis, encephalitis, acute flaccid paralysis or other acute signs of central or peripheral neurologic dysfunction, as documented by a physician and
- Absence of a more likely clinical explanation.

Non-neuroinvasive disease: A clinically compatible case of non-neuroinvasive arboviral disease is defined as follows:

- Fever (≥100.4°F or 38°C) as reported by the patient or a healthcare provider and
- Absence of neuroinvasive disease and
- Absence of a more likely clinical explanation.

Laboratory Criteria for Diagnosis

- Isolation of virus from, or demonstration of specific viral antigen or nucleic acid in, tissue, blood, cerebrospinal fluid (CSF) or other body fluid *or*
- Four-fold or greater change in virus-specific quantitative antibody titers in paired sera *or*
- Virus-specific immunoglobulin M (IgM) antibodies in serum with confirmatory virus-specific neutralizing antibodies in the same or a later specimen *or*
- Virus-specific IgM antibodies in CSF and a negative result for other IgM antibodies in CSF for arboviruses endemic to the region where exposure occurred *or*
- Virus-specific IgM antibodies in CSF or serum.

Case Classification

Probable:

- Neuroinvasive case: A case that meets the above clinical criteria for neuroinvasive disease and with virus-specific IgM antibodies in CSF or serum but with no other testing.
- Non-neuroinvasive case: A case that meets the above clinical criteria for non-neuroinvasive disease and with virus-specific IgM antibodies in CSF or serum but with no other testing.

Confirmed:

- Neuroinvasive case: A case that meets the above clinical criteria for neuroinvasive disease and one or more the following laboratory criteria for a confirmed case:
  - Isolation of virus from, or demonstration of specific viral antigen or nucleic acid in, tissue, blood, CSF or other body fluid or
  - Four-fold or greater change in virus-specific quantitative antibody titers in paired sera or
  - Virus-specific IgM antibodies in serum with confirmatory virus-specific neutralizing antibodies in the same or a later specimen or
  - Virus-specific IgM antibodies in CSF and a negative result for other IgM antibodies in CSF for arboviruses endemic to the region where exposure occurred.
- Non-neuroinvasive case: A case that meets the above clinical criteria for non-neuroinvasive disease and one or more of the following laboratory criteria for a confirmed case:
  - Isolation of virus from, or demonstration of specific viral antigen or nucleic acid in, tissue, blood, CSF or other body fluid or
  - Four-fold or greater change in virus-specific quantitative antibody titers in paired sera or
  - Virus-specific IgM antibodies in serum with confirmatory virus-specific neutralizing antibodies in the same or a later specimen or
  - Virus-specific IgM antibodies in CSF and a negative result for other IgM antibodies in CSF for arboviruses endemic to the region where exposure occurred.

Comment
The seasonality of Powassan virus is predictable. In Ohio, cases could occur from May to September, when the specific vector ticks are active.

Interpreting arboviral laboratory results:

- **Serologic cross-reactivity:** In some instances, arboviruses from the same genus produce cross-reactive antibodies. In geographic areas where two or more closely-related arboviruses occur, serologic testing for more than one virus may be needed and results compared to determine the specific causative virus. For example, such testing might be needed to distinguish antibodies resulting from infections within genera, e.g., flaviviruses such as West Nile, St. Louis encephalitis, Powassan, Dengue, or Japanese encephalitis viruses.
- **Rise and fall of IgM antibodies:** For most arboviral infections, IgM antibodies are generally first detectable at 3 to 8 days after onset of illness and persist for 30 to 90 days, but longer persistence has been documented (e.g. up to 500 days for West Nile virus). Serum collected within 8 days of illness onset may not have detectable IgM and testing should be repeated on a convalescent-phase sample to rule out arboviral infection in those with a compatible clinical syndrome.
- **Persistence of IgM antibodies:** Arboviral IgM antibodies may be detected in some patients months or years after their acute infection. Therefore, the presence of these virus-specific IgM antibodies may signify a past infection and be unrelated to the current acute illness. Finding virus-specific IgM antibodies in CSF or a fourfold or greater change in virus-specific antibody titers between acute- and convalescent-phase serum specimens provides additional laboratory evidence that the arbovirus was the likely cause of the patient's recent illness. Clinical and epidemiologic history also should be carefully considered.
- **Persistence of IgG and neutralizing antibodies:** Arboviral IgG and neutralizing antibodies can persist for many years following a symptomatic or asymptomatic infection. Therefore, the presence of these antibodies alone is only evidence of previous infection and clinically compatible cases with the presence of IgG, but not IgM, should be evaluated for other etiologic agents.
- **Arboviral serologic assays:** Assays for the detection of IgM and IgG antibodies commonly include enzyme-linked immunosorbent assay (ELISA), microsphere immunoassay (MIA) or immunofluorescence assay (IFA). These assays provide a presumptive diagnosis and should have confirmatory testing performed. Confirmatory testing involves the detection of arboviral-specific neutralizing antibodies utilizing assays such as plaque reduction neutralization test (PRNT).
- **Other information to consider:** Vaccination history, detailed travel history, date of onset of symptoms and knowledge of potentially cross-reactive arboviruses known to circulate in the geographic area should be considered when interpreting results.

SIGNS AND SYMPTOMS

POW initially presents as a nonspecific summertime illness with fever, headache, nausea, vomiting and lethargy. Severe disease occurs most commonly in children under the age of 15 and is characterized by seizures, coma, paralysis and a variety of neurological sequelae after recovery. The case fatality rate for POW is very high, in some cases greater than 50%.

DIAGNOSIS

Laboratory diagnosis of arboviral infections is generally accomplished by testing of serum or CSF to detect virus-specific IgM and neutralizing antibodies. During an acute infection, certain viruses can be isolated through culture or detected by nucleic acid amplification.

In fatal cases, nucleic acid amplification, histopathology with immunohistochemistry and virus culture of autopsy tissues can also be useful. Laboratory tests for POW virus infection are not commercially available, but can be requested through ODH laboratories for testing at CDC.

EPIDEMIOLOGY

Source

Humans, woodchucks, snowshoe hares, coyotes, foxes, raccoons, skunks and domesticated cats and dogs are all hosts for this virus.

Occurrence

Cases of Powassan virus have been reported since 1958 from Canada and the Northeast region of the U.S. From 2001-2009, there have been 20 documented case of Powassan virus in the U.S. in Maine, Michigan, Minnesota, New York, Virginia and Wisconsin. There have been no cases reported in Ohio. POW is more common in males and children under the age of 15 years.

Mode of Transmission

Humans contract Powassan virus from the bite of an infected tick, primarily *Ixodes cookei* (Groundhog tick), *Dermacentor andersoni* (Wood tick), *Ixodes spinipalpus* and *Ixodes marxi.*

Period of Communicability

There is no person-to-person transmission, but viremia in humans may last for 7 to 10 days.

Incubation Period

About 1 week.

PUBLIC HEALTH MANAGEMENT

Case

<u>Investigation</u>

If the case is suspect based upon test results of an acute serum sample, obtain a second (convalescent) serum sample to confirm the case diagnosis and sent it to the same laboratory which tested the acute sample. The ODHL will send samples to CDC for confirmation. With serologic evidence of POW infection, a history of travel and locations of potential tick exposure is obtained for the week prior to onset.

<u>Treatment</u>

Some patients require hospitalization, where supportive care is indicated. There is no specific therapy.

<u>Isolation and Follow-up Specimens</u>

Since the diagnosis of Powassan virus may not be suspected initially, enteroviral precautions (i.e. fecal, respiratory) are usually indicated for encephalitis. A

convalescent sample may be required 2-4 weeks after the acute sample to confirm a case.

Public Health Significance
Not known.

Contacts
No treatment or prophylaxis of contacts is indicated.

Prevention and Control
Because *Ix. cookei* are often found on groundhogs and skunks and may be the primary vector of POW virus, environmental controls reducing human contact with small and medium-sized mammals should reduce risk for exposure to POW virus-infected ticks. Persons should keep areas adjacent to their home clear of brush, weeds, trash and other elements that could support small and medium-sized mammals. When removing rodent nests, avoid direct contact with nesting materials and use sealed plastic bags for disposal and to prevent direct contact with ticks.

Vaccination
There is no vaccine.

Vector Investigation
Ticks may be collected and sent to the Zoonotic Disease Program (ZDP), for vector identification. For advice on vector assessment, contact the ZDP at 614-752-1029.

Special Information
Powassan virus is currently the only well documented tick-borne arbovirus occurring in the United States and Canada. Because of the lack of awareness and the need for specialized laboratory tests to confirm diagnosis, the frequency of POW encephalitis may be greater than previously suspected. POW encephalitis should be included in the differential diagnosis of all encephalitis cases occurring in the northeastern United States.

What is POW?
First discovered in 1958 in Canada, POW is a rare illness caused by a virus transmitted by ticks. It typically affects children and males, but everyone is susceptible. POW is one of a group of similar illnesses, including eastern equine encephalitis (EEE), La Crosse encephalitis (LAC) and St. Louis Encephalitis (SLE), which can affect the central nervous system in people and cause severe complications or even death. Patients who recover may have residual neurological problems.

In the United States, most cases of POW are reported from the northeastern states primarily between May and September. Less than 10 cases are diagnosed in the U.S. each year. Ohio has never had a case. Symptomatic infections are most common in children under 15 years of age.

How is POW transmitted?
It is transmitted through the bite of an infected tick. POW has been found in ticks *Ixodes cookei* (Groundhog tick), *Dermacentor andersoni* (Wood tick), *Ixodes spinipalpus* and *Ixodes marxi.* In Ohio, the greatest concern would be *Ixodes cookei*. POW is not directly transmitted from person-to-person.

How long after infection before symptoms appear?
Symptoms usually occur about 1 week after an infected tick bites.

What are the symptoms of POW?
POW can begin as a mild illness with fever, headache, nausea, vomiting and tiredness. People with severe disease, usually children, can have seizures, coma, paralysis and lasting brain damage. Like most other arthropod-borne viruses, POW virus may cause no symptoms, or only mild illness, in some individuals. However, when the virus penetrates the central nervous system (CNS), it can cause encephalitis. POW encephalitis is often associated with significant long-term illness. Of those patients who survive, many suffer permanent brain damage. A significant percentage of cases are fatal.

How is POW treated?
There is no specific treatment for POW. Antibiotics are not effective against viruses, and no effective anti-viral drugs have been discovered.

Is there a vaccine for POW?
There is no human vaccine for POW, and none are currently being developed.

How can I prevent POW?
Prevent tick bites.

- Wear light colored clothing, long sleeves and pants and tuck pants into socks. Cover long, loose hair.
- Spray your clothing with a repellant containing DEET.
- When coming in from outside activities where you might have encountered ticks, throw clothing into the dryer set on high heat. This will ensure no ticks survive on your clothing.
- Do a tick check, take a shower and wash your hair.
- Keep pets that have outside exposure off furniture, especially bedding.

For more information, please visit this Web site:
CDC Information on Arboviral Encephalides
http://www.cdc.gov/ncidod/dvbid/arbor/arbdet.htm