The Neurohospitalist
2019, Vol. 9(4) 181-182

DOI: 10.1177/1941874419844888
journals.sagepub.com/home/NHO

An Overview of Powassan Virus Disease

Murtaza Khan, MD[1], J. David Beckham, MD[1], Amanda L. Piquet, MD[1], Kenneth L. Tyler, MD[1], and Daniel M. Pastula, MD, MHS[1,2]

Keywords
Powassan, Powassan virus, deer tick virus, flavivirus, arbovirus, Ixodes, tick, neurologic

Powassan virus is a tick-borne flavivirus that circulates widely throughout parts of North America and eastern Russia.[1-3] Closely related to tick-borne encephalitis virus, Powassan virus was first identified in an encephalitic child from Powassan, Ontario, in 1958 (though was later retrospectively identified in ticks from northern Colorado from 1952).[2-4] Powassan virus has 2 distinct genetic lineages that are clinically and serologically indistinguishable: lineage 1 (prototype Powassan virus) and lineage 2 (also known as deer tick virus).[1,3] The primary vectors of Powassan virus are *Ixodes* species of ticks including *Ixodes cookei* (lineage 1), *Ixodes marxi* (lineage 1), and *Ixodes scapularis* or the black-legged/deer tick (lineage 2).[1-3] Small- to medium-sized forest rodents are thought to be amplifying hosts.[1,3]

In the United States, there have been 125 human cases of Powassan virus disease reported from 2008 to 2017, mostly from the Northeast and Great Lakes regions.[1] Minnesota (n = 32), Wisconsin (n = 22), New York (n = 16), and Massachusetts (n = 16) reported the highest number of cases during this time period, possibly due to increased burden of disease and/or enhanced surveillance in these states.[1,5] Most cases of Powassan virus disease occur from mid-spring through late fall (peaking in May and June), coinciding with when *Ixodes* species of ticks are most active.[1,5] While all ages groups and both sexes can be affected, there appears to be a male predilection.[1,5] Powassan virus disease has been historically underrecognized, though recognition may be improving with increased arboviral surveillance and education.[5]

Clinically, most Powassan virus infections are thought to be asymptomatic.[1] Among those who develop disease after an incubation period of 1 to 4 weeks, initial symptoms may include fever, headache, and nausea/vomiting.[1,3,6] This may progress to meningitis and/or encephalitis with meningismus, confusion, decreased mental status, focal weakness, cranial nerve palsies, ataxia, and/or seizures.[1,3-6] Cerebral edema and coma has been reported, and approximately 10% of those with Powassan virus disease die.[1,3-6] Among survivors, neurologic sequelae are common including recurrent headaches, cognitive problems, and/or focal neurologic deficits.[1,3,4,6] However, the full clinical spectrum of Powassan virus disease is not known and is still being studied.

Diagnosis of Powassan virus infection is largely serologic by detection of viral-specific immunoglobulin M antibodies followed by confirmatory neutralization antibody tests on the serum and/or cerebrospinal fluid.[1] Rarely, detection of nucleic acid by reverse transcription polymerase chain reaction or antigen by immunohistochemistry may be useful.[1] Cerebrospinal fluid analysis may show a lymphocytic or early neutrophilic pleocytosis with normal glucose.[1,6] Magnetic resonance imaging of the brain may show T2/fluid-attenuation inversion recovery lesions particularly in the deep gray matter, brain stem, and/or cerebellum without significant enhancement, though this may be variable.[6] Pathologically, there may be focal perivascular and parenchymal inflammation consisting of lymphocytes and monocytes.[3]

Treatment of Powassan virus disease is largely supportive with emphasis on seizure prevention and management of any cerebral edema.[1,3,6] No vaccine is currently available. Fortunately, infection is largely preventable through tick bite prevention: using insect repellent, wearing long-sleeved shirts and pants, avoiding brushy areas where ticks quest, and performing tick checks after being outdoors.[1,3,5]

Neurologists should suspect Powassan virus disease in those with meningoencephalitis from spring through fall, particularly if they have had tick exposure in endemic areas.[1,5] Suspected cases should be reported to state or local health

[1] Neuro-Infectious Diseases Group, Department of Neurology and Division of Infectious Diseases, University of Colorado Denver, Aurora, CO, USA
[2] Department of Epidemiology, Colorado School of Public Health, Aurora, CO, USA

Corresponding Author:
Daniel M. Pastula, Department of Neurology, University of Colorado School of Medicine, 12401 East 17th Avenue, Mailstop L950, Aurora, CO 80045, USA.
Email: daniel.pastula@ucdenver.edu

departments who can often facilitate both testing and reporting.

ORCID iD

Daniel M. Pastula, MD, MHS https://orcid.org/0000-0001-9342-4459

References

1. Centers for Disease Control and Prevention. Powassan virus. https://www.cdc.gov/powassan/index.html. Published December 4, 2018. Accessed February 16, 2019.
2. Ebel GD. Update on Powassan virus: emergence of a North American tick-borne flavivirus. *Annu Rev Entomol*. 2010;55:95-110.
3. Hermance ME, Thangamani S. Powassan virus: an emerging arbovirus of public health concern in North America. *Vector Borne Zoonotic Dis*. 2017;17(7):453-462.
4. McLean DM, Donohue WL. Powassan virus: isolation of virus from a fatal case of encephalitis. *Can Med Assoc J*. 1959;80(9):708-711.
5. Krow-Lucal ER, Lindsey NP, Fischer M, Hills SL. Powassan virus disease in the United States, 2006-2016. *Vector Borne Zoonotic Dis*. 2018;18(6):286-290.
6. Piantadosi A, Rubin DB, McQuillen DP, et al. Emerging cases of Powassan virus encephalitis in New England: clinical presentation, imaging, and review of the literature. *Clin Infect Dis*. 2016;62(6):707-713.