7 | EASTERN EQUINE ENCEPHALITIS VIRUS

7.1 | Disease agent

- Eastern equine encephalitis virus (EEEV)

7.2 | Disease agent characteristics

- Family: *Togaviridae*; Genus: *Alphavirus*
- Virion morphology and size: Enveloped, icosahedral nucleocapsid symmetry, spherical particle, 60–65 nm in diameter
- Nucleic acid: Linear, positive-sense, single-stranded RNA genome, ~11.7 kb in length
- Physicochemical properties: Infectivity inactivated and destroyed by heating for 10 min at >56°C; half-life of 7 h at 37°C; sensitive to treatment with lipid solvents, detergents, ether, trypsin, chloroform, formaldehyde, heat, and β-propiolactone; infectivity reduced after exposure to irradiation and inactivated at pH 1–3

7.3 | Disease name

- Eastern equine encephalitis (EEE)

7.4 | Priority level

- Scientific/Epidemiologic evidence regarding blood safety: Theoretical
- Public perception and/or regulatory concern regarding blood safety: Absent
- Public concern regarding disease agent: Very low

7.5 | Background

- First recognized in 1831 as a disease in horses in the northeastern US, with subsequent isolation of the virus from brain tissue in 1933. It was recognized in humans in 1938, following a widespread outbreak in children that resulted in 30 cases of fatal encephalitis.
- Enzootic in North America with most cases of EEE reported between 2010 and 2019 occurring in Massachusetts, Michigan, Florida, Georgia, New York, and North Carolina. EEEV transmission is most common in and around freshwater hardwood swamps in the Atlantic and Gulf Coast states and the Great Lakes region. It also is found in the Caribbean and Central America, inland along the north and east coasts of South America, and the Amazon River basin.
- More than 130 arboviruses are known to cause human disease; most of public health importance belong to the genera *Flavivirus*, *Alphavirus* and *Orthobunyavirus*. Many are nationally notifiable via state reporting to the US CDC (ArboNet); for example, dengue virus, Zika virus, California serogroup viruses, chikungunya virus, EEEV, Powassan virus, St. Louis encephalitis virus, West Nile virus, western equine encephalitis virus and yellow fever virus.
- Classified as bioterrorism agent by the CDC (Category B).

7.6 | Common human exposure route

- Vector borne (mosquitoes)

7.7 | Likelihood of secondary transmission

- Absent

7.8 | At-risk populations

- All age groups, but especially children <10 years old and males; associated with exposure to wooded areas adjacent to swamps and marshes in Eastern US, Canada to Gulf Coast, Caribbean, Latin America
- A threat as a bioterrorist weapon for populations not previously considered being at risk

7.9 | Vector and reservoir involved

- Mosquitoes: *Culiseta melanura*, *Culex* species; associated with wading birds, pheasants, passerine songbirds, and starlings. In addition to *Culex* species, *Aedes* species (e.g., *A. sollicitans* and *A. albopictus*) can act as bridge vectors for humans and horses.

7.10 | Blood phase

- The incidence and duration of asymptomatic viremia are unknown, although up to 96% of people infected with EEEV remain asymptomatic.
- There is a single case report of viral isolation from serum 2 days after onset of illness.

- Viremia has been detected for up to 7 days in horses and <4 days in birds.

7.11 | Survival/persistence in blood products

- Unknown

7.12 | Transmission by blood transfusion

- No transfusion cases have been documented. Conversely, transmission has been reported from an EEEV-infected organ donor to three transplant recipients.

7.13 | Cases/frequency in population

- During 2003–2018, an average of 8 EEE cases (encephalitis/meningitis) were reported annually in the United States (range 4–21 cases). However, in 2019 the CDC recorded 38 neuroinvasive cases. The incidence of cases in counties of origin during those years ranged from <0.2 to >0.5 per 100,000.

7.14 | Incubation period

- 4–10 days

7.15 | Likelihood of clinical disease

- High in children and the elderly. Fewer than 5% of those infected go on to develop encephalitis.

7.16 | Primary disease symptoms

- Headache of increasing severity
- Fever, chills, malaise, and myalgia
- Encephalitis, seizures, coma

7.17 | Severity of clinical disease

- High with death occurring within 2–10 days among patients developing encephalitis.
- Encephalitis occurs in 1 of 8 children and 1 of 23 other patients.
- Following acute encephalitis, up to 80% are left with physical or mental sequelae ranging from mild brain dysfunction to severe intellectual impairment, personality disorders, seizures, paralysis, and cranial nerve dysfunction. Many patients with severe sequelae require long-term care and die within a few years.

7.18 | Mortality

- The case-fatality ratio was 30%–40% of encephalitis cases, being highest among those aged 70 years or older. Among horses, most die within 3–7 days making them good sentinel animals of disease occurring in an area.

7.19 | Chronic carriage

- No

7.20 | Treatment available/efficacious

- Supportive

7.21 | Agent-specific screening question(s)

- No specific question is in use.
- Not indicated because transfusion transmission has not been demonstrated.
- No sensitive or specific question is feasible.
- Under circumstances of a bioterrorism threat, the need for, and potential effectiveness of, specific donor screening questions would need to be addressed.

7.22 | Laboratory test(s) available

- No FDA-licensed blood donor screening test exists.
- IgM EIA in serum or CSF; viral isolation or antigen detection in CSF, blood, or CNS tissue; neutralization tests; NAT.

7.23 | Currently recommended donor deferral period

- No FDA Guidance or AABB Standard exists.
- The appropriate deferral period for clinical infection is not known but would likely be in the order of a few weeks after the resolution of symptoms.

7.24 | Impact on blood availability

- Agent-specific screening question(s): Not applicable; in response to a bioterrorism threat, impact of a local deferral would be of limited efficacy due to the historical lack of transfusion-transmitted disease and short period of viremia.
- Laboratory test(s) available: Not applicable.

7.25 | Impact on blood safety

- Agent-specific screening question(s): Not applicable; unknown impact in response to a bioterrorism threat
- Laboratory test(s): Not applicable

7.26 | Leukoreduction efficacy

- Unknown

7.27 | Pathogen reduction efficacy for plasma derivatives

- Multiple pathogen reduction steps used in the fractionation process have been shown to be robust in the removal of enveloped viruses.

7.28 | Other prevention measures

- Mosquito control and avoidance such as the use of repellents or wearing clothing that minimizes skin exposure.
- There is an experimental vaccine but no specific treatment available.

SUGGESTED READING

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