Ebola Virus

Disease Agent:

- Ebola virus

Disease Agent Characteristics:

- Family: *Filoviridae*; Genus: *Ebolavirus*
- Virion morphology and size: Enveloped, helical, cross-striated nucleocapsid, filamentous or pleomorphic virions that are flexible with extensive branching, 80 nm in diameter and 970-1200 nm in length
- Nucleic acid: Linear, negative-sense, single-stranded RNA, ~18,900 kb in length
- Physicochemical properties: Stable at room temperature and can resist desiccation; inactivated at 60°C for 30 minutes; infectivity greatly reduced or destroyed by UV light and gamma irradiation, lipid solvents, β-propiolactone, formaldehyde, sodium hypochlorite, and phenolic disinfectants

Disease Name:

- Ebola hemorrhagic fever

Priority Level:

- Scientific/Epidemiologic evidence regarding blood safety: Theoretical; there are reasonable scientific grounds to confirm or suggest that viremia is a feature of infection with these agents. Asymptomatic viremia has been neither well studied nor sought aggressively, so there are few or no data to make a critical assessment of risk.
- Public perception and/or regulatory concern regarding blood safety: Very low/Absent
- Public concern regarding disease agent: Moderate

Background:

- Emerging infection clinically affecting humans and nonhuman primates
- Filovirus epidemics have originated from Africa and apparently from a single source in the Philippines.
- 1976: First recognized when two unrelated epidemics occurred in northern Zaire (Democratic Republic of the Congo or DRC) and southern Sudan, with subsequent outbreaks in Sudan, Zaire, Ivory Coast, Gabon, Uganda, DRC, and South Africa
- 1989-1991: Another Ebola subtype discovered in Reston, Virginia, among dying cynomolgus monkeys imported from the Philippines that infected four animal caretakers who remained clinically well. Episodes with the Reston strain occurred in Italy in 1992 and in the US in 1996.
- Classified among the highest priority for bioterrorism agents by the CDC (Category A)

Common Human Exposure Routes:

- Skin or mucous membrane contact with virus-laden materials from sick patients has probably been responsible for most recognized human infections.
- Unsafe needle injections
- Contact with sick or dead monkeys

Likelihood of Secondary Transmission:

- Prominent features of the large Ebola epidemics were secondary nosocomial, parenteral, and contact spread associated with inadequate sterilization of equipment, unsafe injection practices, and lack of basic (barrier) infection control techniques.
- In addition to high viral titers in blood, the skin of patients is extensively infected. This probably accounts for the risk to those participating in traditional preparation of the cadaver and burial traditions.
- Interhuman spread of Ebola virus in the African epidemics has been very extensive among medical staff, often resulting in closure of hospitals and clinics. In Kikwit in 1995, up to 30% of physicians and 10% of nurses were affected, with high case-fatality rates.
- Transmission to household contacts has ranged between 3 and 17%, and was associated with close contact with sick patients and their body fluids.
- Epidemics subsided with using properly sterilized equipment, closure of hospitals, education of the populace, and institution of barrier precautions.

At-Risk Populations:

- Outbreaks in endemic areas and secondary infections have affected healthy populations.
- A threat as a bioterrorist weapon for populations not previously considered being at risk

Vector and Reservoir Involved:

- Despite substantial work, no filovirus vector has been identified.
- Recent work suggests that ape-to-ape transmission may be responsible for the epizootic wave of this disease, although the fruit bat may also act as a reservoir for this disease.

Blood Phase:

- High-titer viremia is present during the acute illness (out to 21 days in Kikwit, DRC outbreak in 1995).
- Prolonged presence of viral RNA in semen and vaginal fluids (>100 days) has been demonstrated in a limited number of patients.
- Asymptomatic viremia before symptoms has not been described but has not been rigorously pursued.

Survival/Persistence in Blood Products:

- Unknown

Transmission by Blood Transfusion:

- Never reported
- Nosocomial secondary spread is strongly associated with parenteral risks, suggesting that blood from ill patients is infectious.

Cases/Frequency in Population:

- Outbreaks are rare and unpredictable, occurring primarily in central Africa, except the Ebola Reston outbreak in the US.
- The Reston strain has not been associated with clinical illness in humans.

Incubation Period:

- 5-10 days (range: 2-19 days) after clinical exposure

Likelihood of Clinical Disease:

- Asymptomatic seropositivity in humans is uncommon suggesting that, with the exception of Ebola Reston, the clinical attack rate is very high, although a small percentage of the clinically unaffected population in epidemic communities has antibodies detected by IgG EIA.

Primary Disease Symptoms:

- Abrupt onset of fever and chills with myalgia, malaise, and headache
- Multisystem involvement follows that includes prostration; nausea, vomiting, abdominal pain, diarrhea and pancreatitis; chest pain, cough, and pharyngitis; vascular and neurologic manifestations.
- Around Day 5, most patients develop a maculopapular rash that is prominent on the trunk followed by desquamation in survivors.
- Central nervous system involvement is often manifested by somnolence, delirium, or coma. Wasting becomes evident later, and bleeding manifestations, such as petechiae and hemorrhages, occur in half or more of the patients.
- During the second week, the patient defervesces and improves markedly or dies in shock with multiorgan dysfunction, often accompanied by disseminated intravascular coagulation, anuria, and liver failure.
- Convalescence may be protracted and accompanied by arthralgia, orchitis, recurrent hepatitis, transverse myelitis, psychosocial disturbances, or uveitis.

Severity of Clinical Disease:

- See mortality

Mortality:

- Ebola Sudan subtype: ~50%; Ebola Zaire subtype: ~80-90%

Chronic Carriage:

- Viremia accompanies the acute stage and disappears about the time of defervescence in survivors during the second week of illness following detection of specific antibody.
- Limited data suggest that viral nucleic acid may persist in some tissues for several months.

Treatment Available/Efficacious:

- Treatment for Ebola hemorrhagic fever is supportive at this time. There is no approved antiviral drug.

Agent-Specific Screening Question(s):

- No specific question is in use; however, current geographic deferrals for malaria and type O HIV would exclude at-risk populations from endemic sub-Saharan Africa if an asymptomatic viremic interval exists.
- Not indicated because transfusion transmission has not been demonstrated.
- No sensitive or specific question is feasible; however, in the event of a repetition of the Reston outbreak, a potential question might inquire about contact with the blood of imported primates or an association with sick primate handlers.
- Under circumstances of a bioterrorism threat, the need for and potential effectiveness of specific donor-screening questions would need to be addressed.

Laboratory Test(s) Available:

- No FDA-licensed blood donor screening test exists.
- Virus culture, antigen detection, immunohistochemistry, and NAT applicable to diverse body fluids and/or tissues, in addition to IgG and IgM antibody serology and electron microscopy, have all proved feasible for diagnostic and epidemiologic studies in various settings for Ebola.

Currently Recommended Donor Deferral Period:

- No FDA Guidance or AABB Standard exists for patients previously diagnosed with Ebola or persons who have had contact with the blood of infected primates or patients.
- There are insufficient data to make recommendations regarding an indefinite or other deferral period.
- The deferral interval because of geographic risk for malaria and group O HIV is expected to be longer than what might be recommended for donors from Ebola endemic areas who have clinically recovered from their disease.

Impact on Blood Availability:

- Agent-specific screening question(s): Not applicable; in response to a bioterrorism threat, impact of a local deferral would be significant.
- Laboratory test(s) available: Not applicable

Impact on Blood Safety:

- Agent-specific screening question(s): Not applicable; assuming that Ebola is transfusion transmissible, it is reasonable to speculate that deferral for a risk of infection will provide some margin of safety. However, the abrupt onset of symptoms following infection makes it unlikely that many infected patients would donate blood.
- Laboratory test(s) available: Not applicable

Leukoreduction Efficacy:

- Data do not exist; however, the observation of virions in electron micrographs of acute serum and the cellular tropism of the virus for endothelial cells and hepatocytes suggests that leukoreduction would not be effective.

Pathogen Reduction Efficacy for Plasma Derivatives:

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

Other Prevention Measures:

- Using properly disinfected equipment and educating health care workers about universal blood precautions are mandatory.

Other Comments:

- BSL-4 biocontainment level

Suggested Reading:

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