## Vaccinia Virus

**Disease Agent:**

- Vaccinia virus

**Disease Agent Characteristics:**

- Family: *Poxviridae*; Subfamily: *Chordopoxvirinae*; Genus: *Orthopoxvirus*
- Virion morphology and size: Enveloped, biconcave core with two lateral bodies, brick-shaped to pleomorphic virions, ~360 × 270 × 250 nm in size
- Nucleic acid: Nonsegmented, linear, covalently closed, double-stranded DNA, 18.9-20.0 kb in length
- Physicochemical properties: Virus is inactivated at 60°C for 8 minutes, but antigen can withstand 100°C; lyophilized virus maintains potency for 18 months at 4-6°C; virus may be stable when dried onto inanimate surfaces; susceptible to 1% sodium hypochlorite, 2% glutaraldehyde, and formaldehyde; disinfection of hands and environmental contamination with soap and water are effective

**Disease Name:**

- Progressive vaccinia (vaccinia necrosum or vaccinia gangrenosum)
- Generalized vaccinia
- Eczema vaccinatum
- Postvaccination encephalomyelitis

**Priority Level:**

- Scientific/Epidemiologic evidence regarding blood safety: Theoretical
- Public perception and/or regulatory concern regarding blood safety: Very low; the existence of any threat of vaccinia to blood safety is dependent on the occurrence of an accidental or intentional release of variola, or a threat of bioterrorism sufficient to require a significant, widespread, reintroduction of smallpox (vaccinia) immunization.
- Public concern regarding disease agent: Absent

**Background:**

- Origin is unknown
- Currently used in smallpox vaccination regimen in individuals who may be exposed to variola (smallpox) proceeding from vesicle to pustule with a maximal response at 8-11 days.

**Common Human Exposure Routes:**

- Intentional dermal inoculation for vaccination
- Accidental infection following transfer from the vaccination site to another site (autoinoculation) or to another person following intimate contact

**Likelihood of Secondary Transmission:**

- Significant following direct contact

**At-Risk Populations:**

- Individuals receiving smallpox (vaccinia) vaccination
- Individuals who come in direct contact with vaccinated persons
- Those at risk for more severe complications of infection include the following:
  - Immune-compromised persons including pregnant women
  - Patients with atopy, especially those with eczema
  - Patients with extensive exfoliative skin disease

**Vector and Reservoir Involved:**

- No natural host

**Blood Phase:**

- Vaccinia DNA was detected by PCR in the blood in 6.5% of 77 military members from 1 to 3 weeks after smallpox (vaccinia) vaccination that resulted in a major skin reaction.
- In the absence of complications after immunization, recently published PCR and culture data suggest that viremia with current vaccines must be rare 3 weeks after vaccination.

**Survival/Persistence in Blood Products:**

- Unknown

**Transmission by Blood Transfusion:**

- Never observed despite the coexistence of extensive immunization activity and blood donation and transfusion during much of the 20th century. However, this was not systematically investigated.

**Cases/Frequency in Population:**

- There is minimal use of the vaccine at this time.
- The source of current concern is speculation about cases occurring upon implementing widespread vaccination programs in anticipation of or response to the reintroduction of smallpox into the population.

**Incubation Period:**

- Complications of immunization tend to occur 7-21 days after inoculation.
- In one study, vaccinia DNA was infrequently detectable up to 21 days after uncomplicated immunization. However, in another study, viral cultures were negative. Published data on the duration of vaccinia viremia are not available.

**Likelihood of Clinical Disease:**

- Low, except in immunocompromised persons

**Primary Disease Symptoms:**

- Generalized vaccinia: Disseminated maculopapular or vesicular rash that occurs because of lymphohematogenous spread 4-19 days following vaccination. Immunocompetent hosts usually experience a benign clinical course, whereas this can be life threatening in immunocompromised persons.
- Progressive vaccinia: Necrotic, locally progressive virus replication in the skin and soft tissue of a vaccination site (generally seen in vaccinees or their contacts with defective cellular or humoral immunity)
- Eczema vaccinatum: Localized or generalized papular, vesicular, pustular, or erosive rash syndrome approximately 5-19 days after exposure through vaccination or close contact with a smallpox vaccinee, with substantial mortality. Lesions have a predilection for areas currently or previously affected by atopic dermatitis.
- Erythema multiforme: Usually benign rash illness after immunization
- Accidental skin infection or keratitis through transference or intimate skin contact
- Postvaccination encephalomyelitis
- Fetal infection
- Cardiomyopathy, myocarditis, pericarditis
- Secondary (bacterial) infection of vaccination site might have an analog if transfusion transmission occurred and resulted in typical vaccinia skin lesions

**Severity of Clinical Disease:**

- Certain postvaccination manifestations carry substantial morbidity and mortality (progressive vaccinia, eczema vaccinatum, heart disease, postvaccination encephalomyelitis, fetal vaccinia, keratitis, erythema multiforme) in the appropriate host.

**Mortality:**

- Mortality rates vary by complication. Range is downward from 25% for postvaccination encephalomyelitis. Historical rates of mortality and severe morbidity may be modified with the availability of modern supportive care, vaccinia immune globulin, and antivirals (e.g., cidofovir).

**Chronic Carriage:**

- Not recognized

**Treatment Available/Efficacious:**

- Uncontrolled data suggest that vaccinia immune globulin may mitigate complications of vaccination.
- Animal models and very limited human data suggest the antiviral agent cidofovir may have clinical activity.

**Agent-Specific Screening Question(s):**

- Currently required by the FDA and included in AABB's Donor History Questionnaire (despite only minimal smallpox (vaccinia) immunization activity at this time):
  - In the past 8 weeks, have you had any vaccinations or other shots?
  - In the past 8 weeks, have you had contact with someone who had a smallpox vaccination?

**Laboratory Test(s) Available:**

- No FDA-licensed blood donor screening test exists.
- Antibody assays might be useful as evidence of immunity.
- Research assays exist for virus isolation, virus detection by direct fluorescent assay in lesion samples, and nucleic acid amplification. None of these are licensed in the US nor are they immediately suitable for high-throughput applications.

**Currently Recommended Donor Deferral Period:**

- 21 days or until vaccination scab separated (longer of the two) for well vaccinees
- 14 days after resolution of all symptoms in vaccinees with complications or in vaccinee contacts with complications
- Prospective donors who are symptomatic after contact with recipients of smallpox vaccine are deferred until complete healing and spontaneous separation of scabs from localized skin lesions, as visually verified by donor room staff. If the scab was otherwise removed, deferral is for 3 months from the vaccination of the source vaccinee. If the date of vaccination of the source is unknown but could have been within the last 3 months, deferral is for 2 months from the donor's attempt to donate.

**Impact on Blood Availability:**

- Agent-specific screening question(s): Minimal in the absence of widespread, emergent, population-based immunization initiatives. Impact will be small in conjunction with local or narrowly targeted immunization programs. Impact will be major with community-wide immunization programs and could be devastating to the blood supply during rapidly implemented, widespread regional or national immunization programs.
- Laboratory test(s) available: Not applicable

**Impact on Blood Safety:**

- Agent-specific screening question(s): Minimal, given lack of evidence of viremia from vaccination in recent studies
- Laboratory test(s) available: Not applicable

**Leukoreduction Efficacy:**

- Unknown
- Cellular tropism studies using primary hematolymphoid cells suggest some viral clearance by leukoreduction can be anticipated.

**Pathogen Reduction Efficacy for Plasma Derivatives:**

- This enveloped virus was inactivated below the limit of detection in one study (that used 6 logs of virus) with pasteurization, caprylate, and solvent-detergent treatments.
- Sterile filtration of plasma for further manufacture reduced titers approximately 4 logs in one study.

**Other Prevention Measures:**

- None

**Suggested Reading:**


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