Polyomaviruses

Disease Agent:

- Polyomaviruses (PVs): BK virus (BKV), JC virus (JCV), simian virus 40 (SV40).

Disease Agent Characteristics:

- Family: *Polyomaviridae*; Genus: *Polyomavirus*
- Virion morphology and size: Nonenveloped, icosahedral nucleocapsid symmetry, spherical particles, 40-45 nm in size
- Nucleic acid: Circular, double-stranded DNA, ~5.0 kb in length with bidirectional transcription
- Physicochemical properties: Inactivated with 0.25% β-propiolactone for 2 hours at 37°C; resistant to organic solvents, freezing and thawing and to heating at 56°C for 2 hours (avian polyomavirus); inactivated by 0.5% sodium hypochlorite and possibly 70% ethanol for 1-5 minutes

Disease Name:

- BKV infection (polyomavirus nephropathy and interstitial nephritis; hemorrhagic cystitis)
- JCV infection (progressive multifocal leukoencephalopathy [PML] in the immunocompromised host)
- SV40 infection (PML-like disease in immunocompromised macaques)

Priority Level

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

Background:

- PVs are prevalent globally in populated areas but are not easily transmitted. Seroconversion to BKV occurs early in life (5-7 years) while that for JCV infections occurs later.
- PML is increasing in frequency, as disease is more frequent in association with HIV/AIDS.
- Viral infection is persistent and usually established in the kidney with high levels of virus excreted in the urine.
- SV40 infects only Old World monkeys and African and Indian macaques. However, from the mid-1950s to the 1963, SV40 was inadvertently introduced into many humans who received contaminated poliovirus vaccines.

Common Human Exposure Routes:

- BKV and JCV infections occur most often in childhood. The route of infection is not clearly established but most likely respiratory, although BK virus is only rarely isolated from the respiratory tract. JCV is easily transmitted from mother to child and is excreted in the urine far more commonly than is BKV. It is reported that 2-3% of the population have JCV in their PBMC, particularly in B-lymphocytes.

Likelihood of Secondary Transmission:

- Unknown

At-Risk Populations:

- Immunocompromised patients, pregnant women, diabetics, and the elderly appear to be at higher risk of disease.

Vector and Reservoir Involved:

- None

Blood Phase:

- BKV and JCV are known to establish long-term latent infections in B-lymphocytes. The detection of viral mRNA in these cells indicates that viral replication is taking place.

Survival/Persistence in Blood Products:

- Unknown

Transmission by Blood Transfusion:

- Never documented
- Disease in organ-transplant recipients and other immunocompromised patients is thought to be a result of reactivation rather than *de novo* infection.

Cases/Frequency in Population:

- BKV: Antibody prevalence is close to 100% by age 11, declining thereafter.
- JCV: Antibody prevalence rises to about 75% in adults.

Incubation Period:

- Acute disease is infrequent, but lifelong persistence of BKV and JCV implies that the incubation period may be extremely prolonged.

Likelihood of Clinical Disease:

- Unknown, but probably low relative to infection rate

Primary Disease Symptoms:

- BKV: Acute respiratory disease has been observed in children. Kidney diseases and especially cystitis or hemorrhagic cystitis have been consistently detected in renal allograft and bone marrow transplant

recipients. As a result, a high rate of renal allograft failure (40%-70%) because of polyomavirus-associated nephropathy has been recorded in addition to hemorrhagic cystitis in children who are bone marrow transplant recipients.
- JCV (PML): Speech and vision impairment, cognitive abnormalities consistent with dementia, muscle weakness and gait disturbance rapidly leading to hemiparesis, cortical blindness and sensory abnormalities are observed that are usually fatal within several months to 1 year of onset, usually in adults. The highest rates occur in patients infected with HIV-1, reaching 5-10%.
- Both viruses may infect the kidney, resulting in viruria.
- All three viruses are oncogenic in experimental animals (rodents, hamsters, New World monkeys, transgenic mice), resulting in different types of tumors. In one study that investigated the prevalence of viral sequences in a series of 225 adult and pediatric brain tumor specimens, nucleotide sequences for JCV, BKV, and SV40 were rarely found to be present.

Severity of Clinical Disease:

- High

Mortality:

- High for PML

Chronic Carriage:

- Lifelong

Treatment Available/Efficacious:

- No consistent results have been seen using drugs to block JCV replication.

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.

Laboratory Test(s) Available:

- No FDA-licensed blood donor screening test exists.
- Serologic tests, NAT, and viral isolation are available.

Currently Recommended Donor Deferral Period:

- No FDA Guidance or AABB Standard exists.

Impact on Blood Availability:

- Agent-specific screening question(s): Not applicable
- Laboratory test(s) available: Not applicable

Impact on Blood Safety:

- Agent-specific screening question(s): Not applicable
- Laboratory Test(s) available: Not applicable

Leukoreduction Efficacy:

- Theoretically efficacious based on tropism for B lymphocytes

Pathogen Reduction Efficacy for Plasma Derivatives:

- This is a nonenveloped virus and thus would not be affected by solvent-detergent treatment.

Other Prevention Measures:

- None

Other Comments:

- Ubiquitous nature, latency in B-lymphocytes, reactivation disease in immunocompromised patients, severity of disease when it occurs, and potential oncogenicity all suggest a need for concern, but there has been no evidence of transmission or disease directly linked to transfusion or transplantation.

Suggested Reading:

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