

VARICELLA-ZOSTER VIRUS

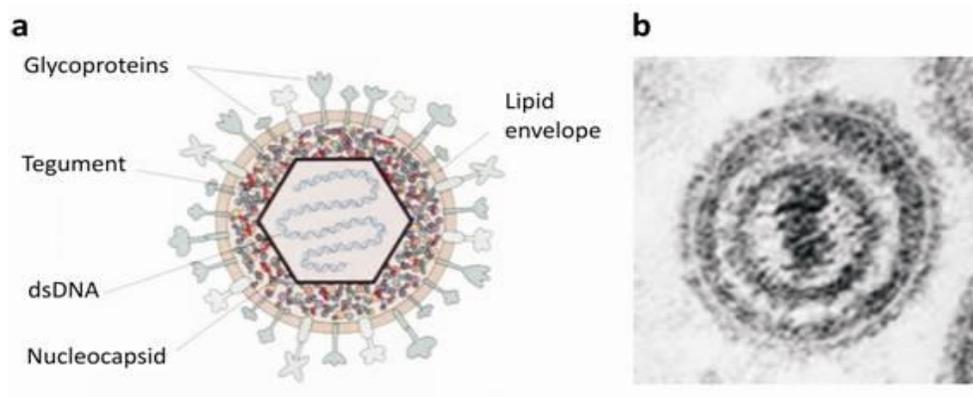
PATHOGEN SAFETY DATA SHEET - INFECTIOUS SUBSTANCES

INFECTIOUS AGENT

NAME: Varicella-zoster virus

SYNONYM OR CROSS REFERENCE: VZV, chickenpox, shingles, Human herpes virus 3, Herpes Zoster.

CHARACTERISTICS: Varicella-zoster virus belongs to the subfamily *Alphaherpesviridae* in the *Herpesviridae* family, genus *Varicellovirus*. The Varicella-zoster virus has a diameter of 150-200 nm and contains a linear, double stranded DNA genome, enclosed within an icosahedral capsid, surrounded by a phospholipid envelope. Varicella-zoster virus grows slowly in human diploid fibroblasts cells, and will remain attached to the host cell, resulting in less circulating viral particles.



Scheme of the varicella-zoster virion¹⁾

Electronic microscopy of varicella-zoster virion (showing the viral DNA surrounded by the capsid, embedded within the tegument and enveloped by the outer viral membrane containing the viral glycoproteins²⁾

HAZARD IDENTIFICATION

PATHOGENICITY/TOXICITY: Varicella (chickenpox) and zoster (shingles) are the two different manifestations of the varicella-zoster virus.

Chickenpox: Varicella/chickenpox is a primary infection with varicella-zoster virus. It occurs mainly in children and is characterized by generalized itchy, vesicular eruptions/rash and fever. The lesions usually first appear on the back of the head and ears, and then spread to

the face, neck, trunk and proximal extremities. The number of lesions may vary from 10 to several hundred. Progressive, generalized varicella may occur, particularly in immunocompromised children and adults. Following acute infection, the virus becomes latent in sensory ganglia neurons and may persist indefinitely.

Shingles: Shingles/zoster is due to reactivation of latent varicella-zoster virus. The risk of acquiring zoster infection increases with age, especially after 50 years of age. It is characterized by a painful eruption of vesicular lesions along with inflammation in the skin area supplied by the associated dorsal root or cranial nerve sensory ganglia.

EPIDEMIOLOGY: Varicella-zoster infections occur worldwide. Varicella/chickenpox is more common in temperate climates than in tropical countries. Before the introduction of varicella-zoster virus vaccine in 1995, an estimated 4 million cases of varicella and 1 million cases of zoster occurred annually in the United States. Most of the varicella cases occurred in children <15 years of age. The disease, however, is more severe in the low percentage of adults who become affected. The incidence of varicella in the United States has declined substantially (overall decrease of 90% between 1995 and 2005, with a 74% decrease among adults), since the introduction of the varicella vaccination program. Varicella-related morbidity and mortality have also declined since the introduction of the vaccine. Shingles/zoster is caused by reactivation of the latent virus, and affects mainly adults. Risk factors for zoster infection include age >50 years, spinal trauma, irradiation, HIV infection, corticosteroid therapy and cancer. The incidence of shingles/zoster declined by 55% among varicella vaccinated children < than 10 years of age, between the years 2001-2006, in the United States. The incidences among adolescents and adults have remained stable or increased since 1995.

HOST RANGE: Humans are the only natural host.

INFECTIOUS DOSE: Unknown

MODE OF TRANSMISSION: The main route of transmission is through aerosols carrying cell-free enveloped varicella-zoster virus particles. Transmission occurs from the skin vesicles of infected persons to the respiratory tract of susceptible person. Transmission can also occur through direct contact with infectious vesicular fluid from an infected person. *In utero* infection can also occur as a result of transplacental passage of virus during maternal varicella infection.

INCUBATION PERIOD: 10-21 days, with an average of 14 days.

COMMUNICABILITY: Varicella-zoster virus is highly contagious. Highly infectious cell-free varicella-zoster viruses, produced in the skin vesicles of patients, are responsible for high degree of contagiousness of this virus. Chickenpox is communicable 1-2 days before onset of rash and approximately 3-4 days after the appearance of rash, until all the vesicles are crusted over. Zoster is less communicable than varicella, but patients with zoster can transmit the virus to susceptible persons.

DISSEMINATION

RESERVOIR: Humans are the only natural host.

ZOONOSIS: None

VECTORS: None

STABILITY AND VIABILITY

DRUG SUSCEPTIBILITY: Acyclovir has been shown to inhibit viral replication. Some strains that are resistant to acyclovir have been reported, mainly in HIV infected patients.

SUSCEPTIBILITY TO DISINFECTANTS: Varicella-zoster virus is easily inactivated by lipid solvents, detergents, and proteases. Although not much information is available on disinfectants specific for varicella-zoster virus, most herpes viruses are susceptible to 30% ethanol, 20% propanol, 200 ppm sodium hypochlorite, 0.12 % orthophenyl phenol, and 0.04% glutaraldehyde.

PHYSICAL INACTIVATION: It is a very fragile virus and can be easily inactivated by heating at 60°C, prolonged storage at a temperature of -70°C and above, extremes of pH (< 6.2 or >7.2), and ultrasonic disruption.

SURVIVAL OUTSIDE HOST: Labile outside host cell. It survives in the external environment for a few hours and occasionally for a day or two.

FIRST AID / MEDICAL

SURVEILLANCE: Monitor for symptoms. Varicella presents with a vesicular rash. Zoster presents with distinct unilateral vesicular rash with dermatomal distribution. Direct examination by electron microscope of skin lesions for virus is the most rapid and sensitive method of identification. Direct examination may be performed using direct fluorescent antibody test, polymerase chain reaction (PCR) of viral deoxyribonucleic acid (DNA). Viral culture is also used from isolated skin lesions and human diploid fibroblasts cells. Other methods employ serological test such as enzyme-linked immunosorbent assay (ELISA).

FIRST AID/TREATMENT: Varicella is a mild and self-limited illness in healthy children; treatment with antiviral agents is not recommended. Non-specific methods such as frequent bathing, calamine lotion, and oatmeal bath can be used for symptomatic relief. Acetaminophen may be given to control fever. Acyclovir (ACV) has been recommended for treatment in healthy patients 12 years or older. Intravenous ACV is used for children, and adults with severe varicella-zoster virus infection or at a risk of developing serious infection such as with immunocompromised patients. ACV is also used for treating zoster in healthy patients, but is not very effective in immunocompromised patients. Oral famciclovir is more effective for treating zoster infection in adults, but is not approved for children or treatment of varicella. Infections resistant to ACV are treated with intravenous foscarnet.

IMMUNIZATION: A live attenuated vaccine, developed from the Japanese Oka strain, is recommended for use in healthy children after 12 months of age. The vaccine can also be used for immunocompetent adults, especially those at occupational risk of acquiring the disease. **PROPHYLAXIS:** Passive immunization with intravenous immune globulin, varicella-zoster immune globulin, if given within 96 hours of exposure, is effective in preventing infection or reducing the severity of disease in susceptible individuals.

LABORATORY HAZARDS

LABORATORY-ACQUIRED INFECTIONS: No infections reported.

SOURCE/SPECIMENS: Vesicular fluids, vesicular lesions, respiratory secretions.

PRIMARY HAZARDS: Direct contact with clinical material or viral isolates, inhalation of concentrated aerosolized materials, droplet exposure of mucous membranes of the eyes, nose, or mouth, ingestion, accidental parenteral inoculation are the primary hazards associated with herpes viruses.

SPECIAL HAZARDS: None

EXPOSURE CONTROLS / PERSONAL PROTECTION

RISK GROUP CLASSIFICATION: Risk Group 2.

CONTAINMENT REQUIREMENTS: Containment Level 2 facilities, equipment, and operational practices for work involving infectious or potentially infectious materials, animals, or cultures.

PROTECTIVE CLOTHING: Lab coat. Gloves when direct skin contact with infected materials or animals is unavoidable. Eye protection must be used where there is a known or potential risk of exposure to splashes.

OTHER PRECAUTIONS: All procedures that may produce aerosols, or involve high concentrations or large volumes should be conducted in a biological safety cabinet (BSC). The use of needles, syringes, and other sharp objects should be strictly limited. Additional precautions should be considered with work involving animals or large scale activities. Women who are or may become pregnant, if seronegative, should consider being vaccinated and restricted from working with this agent.

HANDLING AND STORAGE

SPILLS: Allow aerosols to settle and, wearing protective clothing, gently cover spill with paper towels and apply an appropriate disinfectant, starting at the perimeter and working towards the centre. Allow sufficient contact time before clean up.

DISPOSAL: Decontaminate all wastes that contain or have come in contact with the infectious organism by autoclave, chemical disinfection, gamma irradiation, or incineration before disposing.

STORAGE: The infectious agent should be stored in leak-proof containers that are appropriately labeled.

REFERENCE

Pathogen Safety Data Sheet (PSDS) for varicella-zoster virus has been modified from the ones produced by the Public Health Agency of Canada as educational and informational resources for laboratory personnel working with infectious substances.

- 1) Picture from www.bio.davidson.edu
- 2) Picture from edoc.hu-berlin.de