VESICULAR STOMATITIS

AETIOLOGY

Classification of the causative agent

Vesicular stomatitis virus (VSV) is a member of the family Rhabdoviridae, genus *Vesiculovirus*. There are two distinct immunological classes of VSV recognised: New Jersey (NJ) and Indiana (IND). There are three subtypes of the IND serogroup based on serological relationships: IND-1 (classical IND) IND-2 (cocal virus) and IND-3 (alagoas virus).

Resistance to physical and chemical action

Temperature:	Inactivated by 58°C for 30 minutes
pH:	Stable between pH 4.0 and 10.0
Chemicals/Disinfectants:	Sensitive to formaldehyde, ether and other organic solvents; chlorine dioxide, formalin (1%), 1% sodium hypochlorite, 70% ethanol, 2% glutaraldehyde, 2% sodium carbonate, 4% sodium hydroxide, and 2% iodophore disinfectants, all effective disinfectants.
Survival:	Inactivated by sunlight; survives for long periods at low temperatures

EPIDEMIOLOGY

- Although the VSV has been extensively studied at the molecular level, many unknowns remain regarding its epidemiology
- VSV is known to be transmitted directly via the transcutaneous or transmucosal route
- Certain VS viruses have been isolated from sand flies, black flies mosquitoes and other insects to both pigs and cattle
    - seasonal variation (disappearance at end of rainy season in tropical areas and at first frost in temperate zones) also supports vector-borne transmission
    - hypotheses that the VS virus is a plant virus present in pasture
- In endemic areas, VSV maintains long-term, stable cycles between sand flies and subclinical susceptible hosts; evidence of neutralising antibodies in domestic and wild animals in these areas
- Morbidity rate variable, up to 90% in a herd
- Low mortality rate

Hosts

- Domestic hosts: equidae (horses, donkeys, mules) bovidae, suidae and South American camelids
    - sheep and goats tend to be resistant with few clinical signs.
- Wild hosts: white-tailed deer and numerous species of small mammals in the tropics
- Human (minor zoonosis)
- Experimental host range includes laboratory animals (mice, rats, guinea-pig) deer, raccoons, bobcats, and monkeys

Transmission

- Mechanism of transmission of VSV is unclear
- Contamination by transcutaneous or transmucosal route
- Arthropod transmission: sand flies (*Phlebotomus*, *Lutzomyia* spp.), *mosquitoes* (*Aedes* spp.), black flies (family Simuliidae)
- Experimental transmission of VS NJ has been demonstrated to occur from black flies (*Simulium vittatum*) to domestic swine and cattle

Sources of virus

- Saliva, exudate or epithelium of open vesicles
- Arthropod vectors
- Plants and soil (suspected)

Occurrence

The disease is limited to the Americas; however, it has been described in France (1915 and 1917) and in South Africa (1886 and 1897). Strains of the serotype NJ and subtype IND-1 are endemic in livestock in areas of southern Mexico, Central America, Venezuela, Colombia, Ecuador and Peru. Sporadic activity of NJ and IND-1 VSV has been reported in northern Mexico and western United States. IND-2 has only been isolated from mammals sporadically in Argentina and Brazil. The IND-3 subtype (Alagoas) has been isolated only in Brazil. While VS is not diagnosed in livestock every year in the USA, it is considered to be endemic in feral pigs on Ossabaw Island, Georgia.

For more recent, detailed information on the occurrence of this disease worldwide, see the *OIE World Animal Health Information Database* (WAHID) interface [http://www.oie.int/wahis/public.php?page=home] or refer to the latest issues of the *World Animal Health* and the *OIE Bulletin*.

DIAGNOSIS

Incubation period varies from 2–8 days with an average of 3–5 days. VSV vesicles can develop within 24 hours post-inoculation. In humans, the incubation period can vary from 24 hours to 6 days but is usually 3–4 days. For the purposes of the OIE *Terrestrial Animal Health Code*, the incubation period for VS is 21 days.

Clinical diagnosis

The signs are similar to those of foot and mouth disease (FMD), with which it can easily be confused (but horses are resistant to FMD and susceptible to VS)

- VS cannot be reliably clinically differentiated from the other vesicular diseases, such as foot and mouth disease (FMD), vesicular exanthema of swine (VES), and swine vesicular disease (SVD) when horses are not involved. An early laboratory diagnosis of any suspected VS case is therefore a matter of urgency.
- The incidence of disease can vary widely among affected herds; 10–15% of the animals show clinical signs and these are usually adult animals
- Cattle and horses under 1 year of age are rarely affected
- First manifestation of disease is usually excessive salivation
- Blanched raised or broken vesicles of various sizes in the mouth:
    - Horses: upper surface of the tongue, surface of the lips and around nostrils, corners of the mouth and the gums
    - Cattle: tongue, lips, gums, hard palate, and sometimes muzzle and around the nostrils
    - Pigs: snout
- Lesions involving feet of horses and cattle are not exceptional
- Teat lesions occur in dairy herds
- Foot lesions and lameness are frequent in pigs
- Recovery in few days up to 2 weeks
- Complication: loss of production and mastitis in dairy herds due to secondary infections, lameness in horses
- Morbidity rates vary between 5 and 70 %; mortality is rare
    - higher mortality has been observed with NJ strains in swine

Lesions

- Vesicles, ulcers, erosions, and crusting of muzzle and lips; limited to the epithelial tissues of mouth, nostrils, teats and feet

- The pathogenesis of the disease is unclear, and it has been observed that the humoral-specific antibodies do not always prevent infection with VS serogroup viruses.

Differential diagnosis

Although VS may be suspected when horses are involved as well as pigs and cattle, prompt differential diagnosis is essential because the clinical signs of VS are indistinguishable from FMD when cattle and pigs are affected, and from SVD or VES when only pigs are affected.

Clinically indistinguishable:

- Foot and mouth disease
- Swine vesicular disease
- Vesicular exanthema of swine

Other differential diagnosis:

- Infectious bovine rhinotracheitis
- Bovine viral diarrhoea
- Malignant catarrhal fever
- Bovine papular stomatitis
- Rinderpest
- Bluetongue
- Epizootic haemorrhagic disease
- Foot rot
- Chemical or thermal burns

Laboratory diagnosis

Samples

The sample collection and technology used for the diagnosis of VS must be in concordance with the methodology used for the diagnosis of FMD, VES and SVD, in order to facilitate the differential diagnosis of these vesicular diseases. Note: VS serogroup viruses can be human pathogens and appropriate precautions should be taken when working with potentially infected tissues or virus (see Chapter 1.1.2 Biosafety and biosecurity in the veterinary microbiology laboratory and animal facilities).

Identification of the agent

- Vesicle fluid, epithelium covering un-ruptured vesicles, epithelial flaps of freshly ruptured vesicles, or swabs of the ruptured vesicles; from mouth, feet and other sites of vesicle development
    - animals should be sedated before samples are collected to avoid injury to helpers and for reasons of animal welfare
- When epithelial tissue is not available from cattle, samples of oesophageal–pharyngeal (OP) fluid can be collected by means of a probang (sputum) cup
- In pigs, throat swabs can be taken for submission to a laboratory for virus isolation
- Samples from all species should be placed in containers of Tris-buffered tryptose broth with phenol red, pH 7.6
- If complement fixation (CF) is to be carried out for antigen detection, samples from all species can be collected in glycerol/phosphate buffer, pH 7.2–7.6
    - glycerol is toxic to virus and decreases the sensitivity of virus isolation; it is therefore only recommended for collection of samples for CF test
- Samples should be kept refrigerated if they can arrive at the laboratory within 48–72 hours after collection. For transport periods longer than 72h, samples should be kept frozen in a box containing wet ice and salt. Samples sent frozen with dry ice, precautions should be taken to protect the sample from contact with any CO_2
    - special packaging requirements for shipping samples with dry ice (see Chapter 1.1.1 Collection and shipment of diagnostic specimens, for further information on shipping of diagnostic samples)

Serological tests

- Serum samples from recovered animals can be used for detecting and quantifying specific antibodies
- Paired acute and convalescent serum samples from the same animals, collected 1–2 weeks apart, are preferred for checking the change in antibody titre

Procedures

Identification of the agent

- Virus isolation
    - for identification of VS serogroup viruses and the differential diagnosis of vesicular diseases, clarified suspensions of field samples suspected to contain virus should be submitted for immunological testing
    - for virus isolation, the same samples are inoculated into appropriate cell cultures
    - VS serogroup viruses cause a cytopathic effect (CPE)
    - cell culture can be stained with VS-specific fluorescent antibody conjugate
    - electron microscopy can be a useful diagnostic tool for differentiating the virus family involved
- Enzyme-linked immunosorbent assay - indirect sandwich ELISA (IS-ELISA) is currently the diagnostic method of choice for identification of viral serotypes of VS and other vesicular diseases
- Complement fixation test – less sensitive than ELISA and is affected by pro- or anticomplementary factors
- Nucleic acid recognition methods – PCR can be used to amplify small genomic areas of the VS virus
    - will detect the presence of virus RNA in tissue and vesicular fluid samples and cell culture, but cannot determine if the virus is infectious
    - PCR techniques have not been routinely used for screening diagnostic cases for viruses causing VS

Serologic tests

- Liquid-phase blocking enzyme-linked immunosorbent assay (LP-ELISA) or Competitive enzyme-linked immunosorbent assay (C-ELISA) [prescribed tests for international trade] – used for the identification and quantification of specific antibodies in serum
    - LP-ELISA is the method of choice for the detection and quantification of antibodies to VS serogroup viruses
    - use of viral glycoproteins as antigen is recommended because they are not infectious, allow the detection of neutralising antibodies, and give fewer false-positive results than VN
- Virus neutralisation (VN) [a prescribed test for international trade] – used for the identification and quantification of specific antibodies in serum
    - carried out in tissue culture micro titre plates with flat-bottomed wells using inactivated serum as test sample
- Complement fixation (CF) [a prescribed test for international trade] – used for quantification of early antibodies, mostly IgM

For more detailed information regarding laboratory diagnostic methodologies, please refer to Chapter 2.1.19 Vesicular stomatitis in the latest edition of the OIE *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals* under the heading "Diagnostic Techniques".

PREVENTION AND CONTROL

No specific treatment. Antibiotics may avoid secondary infection of abraded tissues

Sanitary prophylaxis

- Suspicion of disease requires animal movement restrictions including quarantine of infected premises until a confirmatory laboratory diagnosis is performed
    - upon confirmation, these measures must be continued strictly

- In addition, trucks and fomites should be disinfected and subclinically infected animals should be isolated indoors
    - no movement of animals from an infected property for at least 21 days after all lesions are healed; unless the animals are going directly to slaughter
- Insect control may help prevent disease spread; breeding areas should be eliminated or reduced, and insecticide sprays or insecticide-treated ear tags can be used on animals

Medical prophylaxis

- Inactivated and attenuated virus vaccines have been experimentally tested, but are not yet available commercially

For more detailed information regarding vaccines, please refer to Chapter 2.1.19 Vesicular stomatitis in the latest edition of the OIE *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals* under the heading "Requirements for Vaccines".

For more detailed information regarding safe international trade in terrestrial animals and their products, please refer to the latest edition of the OIE *Terrestrial Animal Health Code*.

REFERENCES AND OTHER INFORMATION

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The OIE will periodically update the OIE Technical Disease Cards. Please send relevant new references and proposed modifications to the OIE Scientific and Technical Department (scientific.dept@oie.int). Last updated April 2013.