Swine Vesicular Disease

Porcine Enterovirus Infection

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Importance

Swine vesicular disease is a viral disease, characterized by the formation of vesicles and erosions, that affects only pigs. Although it can cause mild to severe illness, this infection is transient and not life-threatening. Its main significance is the strong resemblance to other vesicular diseases, particularly foot-and-mouth disease. Rapid differentiation of these diseases is critical, as the introduction of foot-and-mouth disease could cause severe economic losses in non-endemic regions. In addition, the stability of swine vesicular disease virus in the environment complicates its eradication and makes prompt recognition essential for control.

Etiology

Swine vesicular disease virus (SVDV) is member of the genus *Enterovirus* in the family Picornaviridae. This virus appears to have evolved from human coxsackievirus B5 (CVB5); SVDV is currently classified as a porcine variant of CVB5, with SVDV an accepted synonym for this variant. One SVDV serotype and a number of strains have been identified. Genetic and antigenic analyses have classified these isolates into at least four phylogenetically distinct groups. Two groups contain viruses found before 1981; the other groups contain more recent European isolates.

Species Affected

Pigs are the only natural hosts for SVDV, but one-day old mice can be infected experimentally. Humans have been infected while working with the virus in the laboratory.

Geographic Distribution

Swine vesicular disease was formerly endemic in much of Europe, but it has been eradicated from all areas except southern Italy. Occasional outbreaks still occur throughout Europe from imported viruses. SVDV was also found in some parts of Asia in the past, and it is still thought to be endemic there.

Transmission

SVDV is highly contagious by direct contact with infected animals or via environmental contamination. This virus can enter the body through broken skin or mucous membranes, and by ingestion. Pigs can excrete SVDV in nasal or oral secretions and feces up to 48 hours before clinical signs are seen. Porcine tissues can also transmit infections if undercooked pork meat or other scraps are fed to swine. Most pigs eliminate the virus within two weeks, with highest viral shedding during the first week, but in rare cases, animals can remain infected for three months or longer. In these persistent carriers, SVDV has been found in nasal secretions and tonsillar tissues, and for particularly long periods in feces. Airborne transmission of this virus is insignificant, and it may not spread between pens unless there is a common open drainage system or the pigs are moved or mixed.

SVDV can survive for long periods in the environment, and significant transmission occurs on fomites. Viable virus has been found in and on worms in the soil where infected pigs were buried, as well as on various other fomites including the nasal passages of farmers. This extremely stable virus is resistant to heat up to 69°C (157°F), although it can be inactivated by holding at 60°C (140°F) for 10 minutes. It can also survive desiccation, freezing and a wide pH range. SVDV remains viable for 4-11 months at pH 2.5 to 12, when the temperature is between 12°C (54°F) and –20°C (-4°F). Under some conditions, it can survive up to two years in dried, salted or smoked meat; under other conditions, it may be inactivated within a year. In addition, SVDV is resistant to most commonly used disinfectants.

Incubation Period

The incubation period is usually 2 to 7 days, but it can be longer if the dose of virus is small.

the Center for Food Security & Public Health
Iowa State University®
College of Veterinary Medicine
Iowa State University
Ames, Iowa 50011
Phone: 515.294.7189
Fax: 515.294.8259
cfsph@iastate.edu
www.cfsph.iastate.edu

Institute for International Cooperation in Animal Biologics
Iowa State University
College of Veterinary Medicine
www.cfsph.iastate.edu/IICAB/

Clinical Signs

Swine vesicular disease is characterized by the development of vesicles and erosions on the legs and around the mouth; the symptoms resemble foot-and-mouth disease and other vesicular diseases. In the earliest stage of vesicle formation, the epithelium is blanched. Vesicles then appear around the coronary bands, in the interdigital spaces and on the skin of the lower legs, particularly at pressure points such as the knees. The vesicles soon rupture, leaving shallow erosions. Vesicles are also seen occasionally on the snout, lips, tongue and teats; they are relatively rare in the oral cavity. Pigs may temporarily become lame or have a decreased appetite for a few days, with slight weight loss; the weight is regained within a short time. Fever up to 41°C (106°F), lasting two to three days, has been reported in some experimental infections; with other strains, no fever was seen. Neurological signs have been reported but are rare; the symptoms may include shivering, unsteady gait, and chorea (rhythmic jerking) of the legs. Abortion is not typically seen. When vesicles occur on the coronary band, the hoof wall separates from the underlying tissues, but complete hoof detachment is rare.

Swine vesicular disease may be subclinical, mild or severe, depending on the virulence of the strain and the husbandry conditions. More severe lesions are seen when pigs are housed on concrete, particularly damp concrete, than on straw bedding or in grass. In addition, the symptoms are usually more severe in young animals. Most pigs recover completely within 2-3 weeks; however, a dark horizontal line may be seen on the hooves where the growth was temporarily interrupted. Death does not usually occur.

Post Mortem Lesions

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The only post mortem lesions are the vesicles seen in live pigs.

Morbidity and Mortality

The morbidity rate varies between herds. The symptoms tend to be more severe in young pigs, and in pigs housed on concrete floors, particularly when it is damp. Most recent outbreaks in Europe have been subclinical or mild. All pens on a farm may not be affected, but in individual pens, the morbidity rate can reach 100%. Deaths are not seen.

Diagnosis

Clinical

Swine vesicular disease should be included in the differential diagnosis when vesicles or erosions are found on the mouth and/or feet of pigs. Unlike other vesicular diseases, pigs are the only species affected. However, vesicular diseases are clinically indistinguishable and must be differentiated with laboratory tests.

Differential diagnosis

The differential diagnoses include foot-and-mouth disease, vesicular stomatitis, vesicular exanthema of swine, and chemical or thermal burns.

Laboratory tests

Swine vesicular disease is often diagnosed by detecting viral antigens in lesion material with an enzyme-linked immunosorbent assay (ELISA). Complement fixation was used to detect antigens in the past, but it has largely been replaced by the ELISA. Immunohistochemistry may also be used. If insufficient material is available for antigen testing (less than 0.5 g) or the test results are negative or inconclusive, virus isolation can be done. SVDV may be recovered in porcine cell cultures including IB-RS-2 cells; a cytopathic effect is seen. The virus is identified with ELISA or reverse-transcription polymerase chain reaction (RT-PCR) assays.

RT-PCR can also detect SVDV in clinical samples including feces. This test is particularly useful when a subclinical infection is suspected or if the samples are collected late in the disease. In research laboratories, viral RNA can also be identified with other nucleic acid techniques including *in situ* hybridization. A one-step multiplex RT-PCR assay for the simultaneous diagnosis of foot-and-mouth disease, swine vesicular disease and vesicular stomatitis was recently published, and may be particularly useful in the early stages before vesicles appear.

Swine vesicular disease is often diagnosed by serology. Because this disease is often mild or subclinical, it may first be suspected during routine surveillance or export certification. The most commonly used serological tests are virus neutralization (the microneutralization test) and ELISAs. Virus neutralization is the definitive test, but takes 2-3 days to perform. ELISAs are often used for surveillance. Up to 1% of normal, unexposed pigs are positive or equivocal on the ELISA, and are retested by virus neutralization. Other serological tests include double immunodiffusion, radial immunodiffusion and counter-immunoelectrophoresis.

Approximately 0.1-0.3% of uninfected pigs are seropositive in both ELISA and virus neutralization tests. These animals, called 'singleton reactors,' may be identified by retesting the positive animal and its cohorts; the absence of seropositive cohorts and a constant, declining or negative second titer suggests that the animal is not infected. In addition, serum from a singleton reactor contains only antigen-specific IgM, while sera from infected pigs usually have specific IgG or both IgG and IgM. In an immunoblot, the serum from singleton reactors displays a wide variety of patterns, while sera from positive animals react almost exclusively with the VP1 protein. The cause of the cross-reaction is unknown; however, usually only one singleton reactor is identified in a herd.

Samples to collect

Before collecting or sending any samples from vesicular disease suspects, the proper authorities should be contacted. Samples should only be sent under secure conditions and to authorized laboratories to prevent spread of the disease. Since vesicular diseases cannot be distinguished clinically, and some are zoonotic, samples should be collected and handled with all appropriate precautions.

Samples from lesions, including vesicular fluid and the epithelial covering, should be submitted for antigen testing and culture. Although SVDV is very stable in the environment, samples should be handled and submitted as if they may contain either SVDV or the more fragile foot-and-mouth disease virus. If possible, at least 1g of epithelium should be collected in PBS with glycerin 50% (pH 7.2-7.4); however, smaller quantities may be cultured. Unclotted whole blood from febrile animals and fecal samples from febrile or nonfebrile animals should also be collected. SVDV can be found in the blood for approximately 7-14 days, but the virus can occur in feces much longer. Serum samples should be collected from both the suspect pigs and unaffected animals in the herd.

Recommended actions if swine vesicular disease is suspected

Notification of authorities

State and federal veterinarians should be informed immediately of any suspected vesicular disease.

Federal: Area Veterinarians in Charge (AVIC):
http://www.aphis.usda.gov/animal_health/area_offices/

State Veterinarians:
http://www.aphis.usda.gov/vs/sregs/official.html

Control

SVDV is extremely persistent in the environment, and this disease is difficult to eradicate once it has been introduced. In the U.K., the first outbreak occurred in 1972, but eradication was only successful after an extensive campaign that lasted ten years. In non-endemic areas, preventative measures include screening imported pigs, restricting the importation of pork products that may contain virus, restricting garbage feeding to pigs, and regulating the disposal of garbage from international airplanes and ships. Routine surveillance and pre- and post-export testing is conducted in some countries, particularly in Europe. Disease detection is complicated by the existence of strains that produce very mild disease or asymptomatic infections. These infections can produce low titers in some pigs; these pigs may be negative in ELISAs, and can be missed by routine surveillance. Although experimental vaccines have been described, no vaccine is commercially available.

Outbreaks are controlled by quarantining infected farms and regions, tracing pigs that may have been exposed, culling all infected and in-contact pigs, and cleaning and disinfecting the affected premises. SVDV is resistant to many common disinfectants and can become re-established from the environment after restocking; for this reason, the choice of disinfectants and procedures is critical. In the presence of organic matter, sodium hydroxide (1% combined with detergent) can be used. In some studies, treatment of pig slurry with 1.5% (w/v) NaOH or Ca(OH)2 for 30 minutes could inactivate SVDV at either 4°C (39°F) or 22°C (72°F). A combination of didecydimethyl-ammonium chloride and 0.1% NaOH for 30–60 minutes has also been promising. Oxidizing agents and iodophors used with detergents work well for personal disinfection in the absence of gross organic matter. All fomites including vehicles must be disinfected. Some recent outbreaks in Italy have been linked to inadequately disinfected vehicles used to move swine. Disposal methods for carcasses must also be considered carefully; SVDV has been found in and on soil worms in areas where infected pigs were buried.

Public Health

SVDV is considered to be a variant of, and appears to have evolved from, the human pathogen coxsackievirus B5. Seroconversion to SVDV has been reported in laboratory workers. Most symptomatic cases have been mild; these infections have been characterized by flu-like illnesses or generalized disease with weakness, abdominal pain and myalgia. However, one case of meningitis was associated with SVDV infection. There are no reports of seroconversion or disease in farmers or veterinarians who have been in contact with infected pigs.

Internet Resources

Food and Agriculture Organization of the United Nations (FAO). Manual for the Recognition of Exotic Diseases of Livestock
http://www.spc.int/rahs/

The Merck Veterinary Manual
http://www.merckvetmanual.com/mvm/index.jsp

United States Animal Health Association. Foreign Animal Diseases
http://www.aphis.usda.gov/emergency_response/downloads/nahems/fad.pdf

World Organization for Animal Health (OIE)
http://www.oie.int

OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals
http://www.oie.int/international-standard-setting/terrestrial-manual/access-online/

OIE Terrestrial Animal Health Code
http://www.oie.int/international-standard-setting/terrestrial-code/access-online/

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