SWINE VESICULAR DISEASE

Swine vesicular disease (SVD) is a viral disease affecting only pigs that was included in the list of diseases notifiable to the OIE because of the similarity of its lesions to those produced by foot and mouth disease (FMD); however, SVD is often mild in nature and may infect pigs subclinically. Due to this and to the current ease of laboratory differential diagnosis, it is no longer a listed disease.

AETIOLOGY

Classification of the causative agent

SVD virus (SVDV) is classified as a pig *enterovirus*, in the family *Picornaviridae*. All isolates are classified in a single serotype, with at least four distinguishable antigenic/genomic variants, which evolved sequentially in different time-periods without overlapping, except for the third and fourth variants that were co-circulating in Italy during 1992–1993. All SVD viruses occurring since then diverge from a common origin and cluster in a unique antigenic/genomic lineage corresponding to the fourth and most recent group; however, two genomic sub-lineages are distinguishable within it. Antigenically, SVDV is related to the human coxsackie virus B5.

Resistance to physical and chemical action

Temperature:	Preserved by refrigeration and freezing. Inactivated by 2 hours at 56°C and by 30 minutes at 60°C
pH:	Extremely stable virus; it is stable in the pH range 2.5–12.0
Disinfectants/chemicals:	In the presence of organic matter, inactivated by sodium hydroxide (1% combined with detergent). Direct treatment of swine waste with 1.5% (w/v) NaOH or $Ca(OH)_2$ for 30 minutes could inactivate SVDV at either 4°C or 22°C. Mixture of didecydimethylammonium chloride and 0.1% NaOH for 30–60 minutes also demonstrates efficacy. For personal disinfection and in the absence of gross organic matter, disinfectants, such as oxidising agents, iodophores, acids etc., are suitable if combined with detergents
Survival:	SVDV can survive for long periods in the environment, and significant transmission occurs with fomites. Resistant to fermentation and smoking processes. Under some conditions, it can survive up to two years in dried, salted or smoked meat May remain in hams for 180 days, dried sausages for >1 year, and in processed intestinal casings for >2 years

EPIDEMIOLOGY

Movement of subclinically infected animals is the most common means of moving SVDV. Transport of large numbers of swine often results in small lesions and these provide a portal of entry for the SVDV. Introduction of susceptible swine into contaminated environments will also result in SVD outbreaks. Non-heat-treated garbage fed to swine provides another means for infected meat to cause disease.

- 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%

Hosts

- Swine (domestic and wild pigs) are the only natural host for SVDV

Transmission

- Virus infects swine via: lesions in skin and mucosa, ingestion and inhalation
- Direct contact among infected swine or with their excretions
    - very low titres of virus needed to infect animals across broken skin

- faecal contamination is a major source of virus spread, often within contaminated vehicles or premises

Sources of virus

- Affected pigs may excrete virus from the nose and mouth and in the faeces up to 48 hours before the onset of clinical signs
- Most virus is produced in the first 7 days after infection
  - virus excretion from the nose and mouth normally stops within 2 weeks
  - virus may continue to be shed for up to 1 month in the faeces, very rarely up to 3 months
- All tissues contain virus during the viraemic period
  - SVDV not inactivated by pH change associated with *rigor mortis* is present in meat scraps and 'swill' derived from infected pigs
- Ruptured vesicles (epithelium and fluid) are a high-titre source of virus; faeces are a lower-titre source of virus
- 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.

Occurrence

After its first detection in Italy in 1966, the disease occurred in Europe during the 1970s and 1980s and was also detected in far east Asia. Since then, it has only been sporadically reported, mainly from Italy, where it has been controlled and finally eradicated through an active virological and serological surveillance plan. Since 2019, all Italian territories have been recognised SVD-free.

Given the subclinical occurrence of SVD, as observed in most recent outbreaks in Europe, and lack of knowledge about active surveillance in place in OIE member countries, except for Italy, evidence-based knowledge on SVD absence in the world is not available.

Outbreaks of an idiopathic vesicular disease of swine have been reported in Canada in 2007, in the U.S. Brazil and Columbia in subsequent years and since 2015 also in south east Asia (China [People's Rep. of], Thailand, Vietnam). However, the identified agent was a *Senecavirus* type A (SV-A), which also belongs to *Picornaviridae* family. There have been several refereed publications documenting identification of SV-A from pigs with idiopathic vesicular lesions.

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]

DIAGNOSIS

The incubation period for SVD is between 2 and 7 days,

Clinical diagnosis

SVD can be a subclinical, mild or severe vesicular condition depending on the strain of virus involved, the age of pigs affected, the route and dose of infection, and the husbandry conditions under which the pigs are kept. The clinical signs of SVD may easily be confused with those of FMD and any outbreaks of vesicular disease in pigs must be differentiated by laboratory confirmation. Recent outbreaks of SVD have been characterised by less severe or no clinical signs; infection has been detected when samples are tested for a serosurveillance programme or for export certification.

- The first sign of disease may be sudden appearance of lameness in several animals in a group in close contact and a transient fever of up to 41°C
  - off feed for a few days
- Vesicles then develop on the coronary band, typically at the junction with the heel, and interdigital spaces of the feet
  - may affect the whole coronary band resulting in loss of the hoof
- More rarely, vesicles may also appear on the snout, particularly on the dorsal surface, on the lips, tongue and teats, and shallow erosions may be seen on the knees
- On hard surfaces, animals may be observed to limp, stand with arched back, or refuse to move even in the presence of food

- Clinical signs are more severe in wet or unsanitary conditions and abrasive floors and conversely pigs kept on grass or housed on deep straw may demonstrate little or no clinical signs
- Nervous signs have been reported, but are unusual
- Young animals are usually more severely affected by SVD
- Abortion is not a typical feature of SVD
- Recovery occurs usually within 2–3 weeks; only evidence of infection being a dark, horizontal line on the hoof where growth has been temporarily interrupted
- Morbidity reached 100% in some old outbreaks but in more recent ones the disease produced only mild clinical signs or occurred subclinically and usually no deaths are associated

Lesions

- Vesicle formation is the only known lesion directly attributable to the infection
    - these lesions are indistinguishable from FMD and other vesicular disease in pigs

Differential diagnosis

- Foot-and-mouth disease
- Vesicular stomatitis
- Vesicular exanthema of swine
- Chemical or thermal burns
- Idiopathic vesicular disease (*Senecavirus*)

Laboratory diagnosis

Samples

Any vesicular condition in pigs may be FMD. Once suspicion of FMD has been eliminated, the diagnosis of SVD requires the facilities of a specialised laboratory.

- Clinical disease
    - investigation should start with the examination of a 10% suspension of lesion material in phosphate buffered saline (PBS) or tissue culture medium and antibiotics
- Subclinical disease
    - faecal samples are the specimen of choice. Faecal samples can be collected from individual pigs or from the floor of premises suspected to contain, or to have contained, pigs infected with SVD. The level of virus in faeces is usually insufficient for detection by ELISA and the use of RT-PCR and/or virus isolation is required
    - Serum samples for antibody detection collected from unaffected pigs in a suspect case

Procedures

Identification of the agent

- Virus Isolation
    - It is the reference method and should be used if a positive ELISA or RT-PCR result is not associated with the detection of clinical signs of disease, the detection of seropositive pigs, or a direct epidemiological connection with a confirmed outbreak

- Immunological methods
    - Enzyme-linked immunosorbent assay (ELISA): detection of SVD viral antigen by a sandwich ELISA performed with polyclonal (rabbit and guinea pig immune sera) or monoclonal antibodies, used as capture and detector antibody
        - Given lower sensitivity than Viral Isolation and RT-PCR, ELISA for antigen detection is only suited to test lesions tissue homogenates or to identify SVDV in infected cell cultures, i.e. samples which contain high titres virus

- Nucleic acid recognition methods
    - reverse transcription followed by the PCR (RT-PCR) is a useful method to detect SVD viral genome in a variety of samples from clinical and subclinical cases
    - several methods have been described, with best diagnostic performance with capability to reveal all the circulated genomic sublineages shown by classical or real-time RT-PCR assays targeting a SVDV 3D region

- RT-PCR has the same diagnostic value as Viral Isolation but allows faster results and is the test of choice for faecal samples, since it is not affected by other enteroviruses frequently present in faeces that may outgrow SVDV in cell cultures.

Serological tests

Because SVD may be mild or subclinical, SVD is often diagnosed solely on the evidence of serological tests performed for disease surveillance or export certification.

- Virus neutralisation
  - quantitive microtest for antibody neutralising SVD virus is performed using IB-RS-2 cells (or suitable susceptible porcine cells) in flat-bottomed tissue-culture grade microtitre plates
  - positive cut-off titres depend on the cell system used; laboratories should establish their own criteria by reference to standard reagents available from the OIE Reference Laboratories

- Enzyme-linked immunosorbent assay (competitive ELISA developed by Brocchi *et al*.)
  - the inactivated SVD virus is trapped to the solid phase using the monoclonal antibody (MAb) 5B7
  - serum samples and the peroxidase-conjugated MAb 5B7 are incubated simultaneously; positive sera inhibit the binding of the conjugated MAb
  - after development of the reaction by addition of substrate and chromogen, results are expressed as the percentage inhibition by each test serum of the standard calibrated reaction

A small proportion of sera from naïve pigs may react positively in serological tests for anti-SVDV antibody (0.1% of the original population in a system based on screening by competitive ELISA and conformation by VNT). These false-positive animals are called “singleton reactors”, since they occur as single cases in a herd and their reactivity is transient.

For more detailed information regarding laboratory diagnostic methodologies, please refer to Chapter 3.8.8 Swine vesicular disease in the latest edition of the OIE *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals* under the heading “Diagnostic Techniques”.

PREVENTION AND CONTROL

Sanitary prophylaxis

- In non-endemic areas:
  - Preventative measures such as 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 are conducted in some countries, particularly in Europe

- On outbreaks
  - Quarantining infected farms and regions
  - Tracing pigs that may have been exposed
  - Culling all infected and in-contact pigs
  - Cleaning and disinfecting the affected premises.

Medical prophylaxis

- No treatment
- There are currently no commercial vaccines available against SVD

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*.

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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 January 2020