



CLASSICAL SWINE FEVER (CSF) (Hog Cholera, European Swine Fever)

ANIMAL GROUP AFFECTED	TRANSMISSION	CLINICAL SIGNS	FATAL DISEASE ?	TREATMENT	PREVENTION & CONTROL
Domestic pigs and wild boars	Direct contact, oronasal, lacrimal secretions, urine, faeces, insemination, blood transfer, feeding of raw or insufficiently cooked meat, transplacental infection	Anorexia, severe depression, diarrhoea, constipation, high fever, conjunctivitis, superficial and internal hemorrhages, prolonged and intermittent in chronic form, intrauterine infection: stillbirth, mummification	In acute form morbidity and mortality can be high	Strict eradication	Serological monitoring system, strict importation restrictions, no garbage/meat feeding

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Susceptible animal groups Domestic pigs and wild boars.	
Causative organism Classical swine fever virus (CSFV) is an enveloped single-stranded RNA virus of positive polarity in the family Flaviviridae, genus Pestivirus. There is only one serotype with minor antigenic variants. CSFV has a close antigenic relationship with bovine viral diarrhoea virus (BVDV) and border disease virus (BDV) of sheep.	
Zoonotic potential Humans are not susceptible to CSFV infection.	
Distribution Currently CSF is recognised in 36 countries and suspected in another 2. It was eradicated in Canada, New Zealand, Australia, Scandinavia, Switzerland, and the USA. Constant progress toward eradication has been made in the EC since the guidelines for CSF control in individual member states were accepted in 1980.	
Transmission Primarily faecal-oral, but infection can occur through the conjunctiva, mucous membranes, skin abrasions, insemination, and percutaneous blood transfer (e.g. iatrogenic). Pigs are the only natural reservoir of CSFV (wild boar reservoir). Blood, tissues, semen, secretions and excretions contain CSFV. Contact with infected pigs is the principal source of infection with CSFV. Feeding of raw or insufficiently cooked meat or contaminated food (access of infected wild boars to food source) is a potent source of CSFV. Airborne transmission is not thought to be important, but could occur between mechanically ventilated buildings within close proximity to each other. During the warm season, mechanical vectors such as insects may carry CSFV; however, there is no evidence that CSFV replicates in invertebrate vectors. Husbandry methods also play an important role in CSF transmission (mixing ejaculates from different boars for artificial insemination). Rodents and working personal play a crucial role as carriers ("Händlerseuche"). Transplacental infection ("carrier-sow" syndrome) with viral strains of low virulence often results in persistently infected piglets (major cause of virus dissemination). In a protein-rich environment, CSFV is very stable and can survive for months in refrigerated meat and for years in frozen meat. The virus is sensitive to drying (desiccation) and is rapidly inactivated by a	



pH of less than 3 and greater than 11.

Incubation period

Usually 3 to 4 days, but can range from 2 to 14 days.

Clinical symptoms

The clinical signs of CSF are highly variable and strongly determined by the virulence of the strain, age of the pigs and to a lesser extent on the breed and condition of the animals. CSF occurs in an acute, a subacute, a chronic, or a persistent form. Virulent and moderately strains of CSF cause the acute and subacute form of the disease, whereas strains of low virulence induce a relatively high proportion of chronic infections that may be inapparent or atypical. In general, signs of disease are less marked in adult pigs. In addition congenital CSFV infection by virulent strains will likely result in abortions or weak born pigs that will die shortly after birth. Transplacental transmission with low-virulence strains may result in the reproductive form. **Acute form:** Pigs are pyretic (>40° C) with severe depression, reduced appetite, cutaneous cyanosis, conjunctivitis, anorexia, constipation followed by severe diarrhoea (“cholera”), convulsions and death. Subacute form: pyrexia, diarrhea, central nervous disease and low mortality, less severe than acute form. **Chronic form:** prolonged and intermittent disease periods with depression, anorexia, and fever, alternating diarrhea and constipation, less severe than in the acute form, recovery is occasionally seen in mature animals. Chronically infected pig may have a disproportionately large head relative to the small trunk, may stand with arched backs and their hind legs placed under the body. Reproductive form: small litter size, mummified, stillborn and weakborn pigs, “poor doing”/ill thrift pigs. Congenital tremors, malformation of the visceral organs and cerebellar hypo- or aplasia (see BVD in cattle) occur rarely. Some pigs may be born virtually healthy but persistently infected with CSFV (exposure of foetuses to CSFV of low virulence in the first trimester of foetal life). Persistently infected pigs do not produce neutralizing antibodies to CSFV and have a lifelong viremia. It may take several months (>6) before those pigs develop mild anorexia, depression, conjunctivitis, dermatitis, diarrhoea, runting, and locomotive disturbance leading to paresis and death. Poor reproductive performance may be the only sign of disease caused by low virulence strains of CSFV.

Post mortem findings

The most common lesion observed in pigs dying of acute CSF is hemorrhage. Gross lesions are most often observed in kidneys and lymph nodes. Kidneys have cortical and less commonly medullary petechiae or echymoses. Lymph nodes frequently have diffuse edema and hemorrhage in sinusoids creating a “marbled” appearance. Frequent gross lesions also include mucosal hemorrhage in the urinary bladder, splenic infarcts and laryngeal and epiglottal hemorrhages. Characteristic but less frequent lesions are multifocal caseous necrosis of tonsillar crypts and diffuse subserosal hemorrhages and/or catarrhal mucosal inflammation in the small and large intestine. Accumulation of straw-coloured fluids in the peritoneal and thoracic cavities and in the pericardial sac may be present. The lungs are congested and hemorrhagic and have zones of bronchopneumonia (secondary). In **chronic cases**, the colonic mucosa contains multifocal ulcers with white caseous necrotic centres (“button ulcers”). Chondrodysplasia causing widening of the costochondral junction of the ribs and at the growth plates of long bones may be observed in growing pigs that survive more than 30 days post infection. In **pigs infected transplacentally** with CSFV strains of low virulence, the most common lesions are hypoplasia of the cerebellum, thymus atrophy, ascites, and deformities of the head and of the limbs. Edema and petechiae of the skin and the internal organs occur at the terminal stage of the disease.

Microscopic lesions: Predominantly in capillaries and small arteries in organs with gross lesions and in the brain. Lymphoid lesions are the most prominent and consistent, resulting in lymph node swelling, necrosis and variable hemorrhage in the submandibular, gastrohepatic, renal, and mesenteric lymph nodes. The spleen may have multifocal marginal infarcts. Endothelial infections cause endothelial swelling of affected vessels that may occlude the lumen. Edema and reticular cells expand the intima. The media may be thickened by edema fluid or hyaline (fibrinoid necrosis). Vessels may be surrounded by hemorrhage. Glomerular capillaries and splenic and colonic submucosal arteries are often thrombosed. In contrast, arteries in the brain rarely contain thrombi but are surrounded by prominent cuffs of lymphocytes, especially in the Virchow-Robin spaces. There may also be small multiple discreet foci of glial proliferation in the white matter. Epithelial infections may occur throughout the digestive tract and in the tonsils and sometimes cause crypt necrosis and abscesses. Changes in the small and large intestine may include catarrhal, hemorrhagic or ulcerative (common in chronic infections) enterocolitis.

Diagnosis

In the early phase of the disease, clinical signs are by no means all present and not a single symptom is pathognomonic for CSF. Septicemic conditions in which pigs have high fever should be carefully investigated. Septicemic bacterial diseases, including *Salmonella choleraesuis*, *Actinobacillus suis*, *Hemophilus parasuis* and *Erysipelothrix rhusiopathiae* may all cause similar clinical symptoms and lesions. Marked leukopenia is common at the onset of high fever and persists throughout the course of the disease. Approximately 75 % of pigs infected with acute CSF have microscopic lesions of a viral meningoencephalitis. Laboratory methods are based on 3 pillars:

1. Detection of viral antigen in tissues
2. Virus isolation

**3. Detection of specific antibodies.**

A direct fluorescent antibody test (FAT) is used to detect CSF viral antigens in frozen tissues of organs from dead pigs, in biopsy material, or in impression smears.

There is a close antigenic relationship between CSFV and other pestiviruses, evidenced by cross-reactions in immunodiffusion, FAT and to a lesser extent neutralization tests (NT). CSFV can be differentiated from BVDV or BDV with an immunoperoxidase (IP) test using monoclonal antibodies, but not by FAT. Both the direct FAT and immunohistochemistry demonstrate CSFV antigen in the tonsillar crypt, surface epithelium, and germinal centers. Confirmation of the results with cell culture is recommended.

Reverse transcriptase polymerase chain reaction (RT-PCR) is a useful and relatively rapid method for detection and differentiation of pestiviruses. Continuous random serological surveillance programs are important, and may be the only way of detecting the occurrence of CSF strains of low virulence.

ELISAs, complex trapping blocking ELISA, and indirect immunoperoxidase tests are available for serologic testing. It is important to note that antibodies are at the earliest detectable 2-3 weeks following onset of disease and in experimental studies only the NT using homologous virus detected all animals.

Material required for laboratory analysis

Virus isolation and antigen detection: Palatine tonsils (site of early infection, 2 days p.i.), submandibular, gastro-hepatic, and mesenteric lymph nodes, thymus, spleen, kidney, lower ileum, cecal tonsil, and brain (refrigerated, but not frozen), heparinized blood for virus isolation, serum. A complete set of tissues, including the whole brain, should be submitted in 10 % buffered formalin for histopathology.

Live pigs: Tonsillar biopsies and whole blood collected with anticoagulants from pigs that have fever or show other signs of the disease. Serum samples for antibody detection from animals that have recovered from suspected infection or from sows that have been in contact with infected or suspected cases.

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Treatment

There is no treatment for CSFV infected pigs. Currently, nearly all vaccines on the market are modified live virus (MLV) vaccines rendered non-pathogenic for pigs over 2 weeks of age and are safe to use in pregnant sows. MLV vaccines will replicate in the tonsil and other lymphoid tissues and antigen will be detectable for up to 10 days following vaccination. Vaccination will complicate the interpretation of diagnostic tests. Monoclonal antibodies can distinguish C strain vaccine from field viruses using direct IP staining of tissues, but this requires an additional test. Vaccinated animals with conventional vaccines cannot be serologically distinguished from pigs recovered from CSF. Subunit vaccines based on the sequence of the E2 region are currently available and were effective in experimental trials, but have not been used in the field. It is possible to distinguish pigs vaccinated with a subunit vaccine from pigs that recovered from a field strain of CSFV.

Prevention and control in zoos

Control measures will be assisted by strictly enforcing the garbage cooking laws, having an effective swine identification system, and using serological surveys targeted primarily to breeding sows to detect subclinical infections. The threat of reintroduction is significant and it is essential to initiate an effective serological monitoring system. Strict importation restrictions must be applied to pigs and pork products originating from countries where CSF is present to prevent outbreaks. Garbage feeding must be stopped or carefully regulated to insure proper cooking. Temperatures of 70 C for a minimum of 60 min inactivate the virus

Suggested disinfectant for housing facilities

Inactivated by cresol, sodium hydroxide (2%), formalin (1%), sodium carbonate (4% anhydrous or 10% crystalline, with 0.1% detergent), ionic and non-ionic detergents, strong iodophors (1% in phosphoric acid, lipid solvents such as chloroform, examples of effective disinfectants: potassium peroxymonosulfate (Antec Virkon S at a dilution rate of 1:100); hypochlorites (bleach, Chlorox (The Chlorox Company) at a dilution rate of 1:32 (only in the absence of organic material, disinfectant properties of sodium hypochlorite are inactivated by organic material and diminished by alkaline materials (lime) and moisture, contact with skin is irritating), phenols and related compounds, e.g. cresols, 1 Stroke Environ® (Calgon Vestal), Tek-Trol (Bio-Tek Industries, Inc.) at 1-2% concentrations, not inactivated by organic debris, disinfectant properties are enhanced by warm temperatures, and diminished by cold temperatures and moisture, contact with skin is corrosive and the use of goggles and rubber gloves is recommended

Notification

Yes

Guarantees required under EU Legislation**Guarantees required by EAZA Zoos****Measures required under the Animal Disease Surveillance Plan****Measures required for introducing animals from non-approved sources****Measures to be taken in case of disease outbreak or positive laboratory findings****Conditions for restoring disease-free status after an outbreak****Contacts for further information****References**

1. Anonymous. 1996. OIE Manual of standards for diagnostic tests and vaccines. Lists A and B diseases of mammals, birds, and bees, 3rd ed. Pp. 145-154.
2. Cheville, N. F., and W. L. Mengeling. 1969. The pathogenesis of chronic hog cholera (swine fever). Histologic, immunofluorescent, and electron microscopic studies. Lab. Invest. 20: 261-274.
3. Colijin E., R. Bloemraad, and G. Wensvoort. 1997. An improved ELISA for the detection of serum antibodies directed against classical swine fever virus. Vet. Microbiol. 59: 15-25.
4. Dahle, J., and B. Liess. 1992. A review on classical swine fever infections in pigs: epizootiology, clinical disease and pathology. Comp. Immun. Microbiol. Infect. Dis. 15: 203-211.
5. Depner, K. R., T. Bauer, and B. Liess. 1992. Thermal and pH stability of pestiviruses. Rev. Sci. Tech. OIE 11: 885-893.
6. Depner, K. R., T. Muller, E. Lange, C. Staubach, and J. Teuffert. 2000. Transient classical swine fever virus infection in wild boar piglets partially protected by maternal antibodies. Dtsch. Tierarztl. Wochenschr.



- 107: 66-8.
7. De Smit, A. J. 2000. Laboratory diagnosis, epizootiology, and efficacy of marker vaccines in classical swine fever: a review. *Vet. Q.* 22: 182-8.
 8. De Smit, A. J., A. Bouma, C. Terpstra, 1999. Transmission of classical swine fever virus by artificial insemination. *Vet. Microbiol.* 67: 239-249.
 9. Edwards, S., and J. J. Sands. 1990. Antigenic comparisons of hog cholera virus isolates from Europe, America and Asia using monoclonal antibodies. *Dtsch. Tierärztl. Wochenschr.* 29: 101-108.
 10. Elbers, A. R. W., J. A. Stegeman, H. Moser, 1999. The classical swine fever epidemic 1997-1998 in the Netherlands: Descriptive epidemiology. *Prev. Vet. Med.* 42: 157-184.
 11. Emerson, J. L., and A. L. Delez. 1965. Cerebellar hypoplasia, hypomyeliogenesis, and congenital tremors of pigs associated with prenatal vaccination of sows. *J. Am. Vet. Med. Assoc.* 147: 47-54.
 12. Hanson, R. P. 1957. Origin of hog cholera. *J. Am. Vet. Med. Assoc.* 131: 211-218.
 13. Katz, J. B., J. F. Ridpath, and S. R. Bolin. 1993. Presumptive diagnostic differentiation of hog cholera virus from bovine viral diarrhoea and border disease viruses by using a cDNA nested-amplification approach. *J. Clin. Microbiol.* 31: 565-568.
 14. Mebus, C. A., M. Arias, J. M. Pineda. 1997. Survival of several porcine viruses in Spanish dry-cured meat products. *Food Chem.* 59: 555-559.
 15. Ressang, A. A., and J. L. den Boer. 1968. A comparison between the cell culture, frozen tissue section, impression and mucosal smear techniques for fluorescent antibody in the diagnosis of hog cholera. *Neth. J. Vet. Sci.* 1: 72.
 16. Terpstra, C. 1990. Manual of Recommended Diagnostic Techniques and Requirements for Biological Products for List A & B Diseases. OIE Manual: Vol. II. Pp. 1/15-15/15.
 17. Van Oirschot, J. T. 1979. Experimental production of congenital persistent swine fever infections I. Clinical, pathological and virological observations. *Vet. Microbiol.* 4:117-132.