

Porcine Rubulavirus Infection

*Blue Eye Disease,
Enfermedad del Ojo Azul,
La-Piedad-Michoacan
Paramyxovirus Infection*

Last Updated: March 2017



IOWA STATE UNIVERSITY
College of Veterinary Medicine



- OIE Collaborating Centres:
- Diagnosis of Animal Disease and Vaccine Evaluation in the Americas
 - Day-One Veterinary Competencies and Continuing Education



www.cfsph.iastate.edu
Email: cfsph@iastate.edu

Importance

Porcine rubulavirus infection, or “blue eye” disease, is an illness that has been reported only from Mexico. This virus, which affects pigs, first emerged in the 1980s and has since become a serious concern for the Mexican swine industry. Blue eye disease is typically characterized by encephalitis, respiratory disease and high mortality in young piglets, self-limited respiratory disease in growing pigs and reproductive failure in adults. There have been occasional reports of more severe outbreaks, with neurological signs in weaned and adult swine. Corneal opacity, the sign for which the disease is named, occurs in only a small number of animals.

Etiology

Blue eye disease is caused by porcine rubulavirus, a member of the genus *Rubulavirus* in the family Paramyxoviridae. This virus is occasionally called the La-Piedad-Michoacan paramyxovirus. There are a number of viral strains, which can differ in virulence.

Species Affected

Domesticated pigs are the only known hosts for porcine rubulavirus. The susceptibility of other members of the pig family is currently unknown.

Zoonotic potential

While a recent study found antibodies to porcine rubulavirus in a small percentage of Mexican veterinarians, there is currently no evidence that this virus affects humans.

Geographic Distribution

Blue eye disease has been reported only from Mexico. It is endemic in the central and west-central regions, which are the major swine-producing areas, and serological evidence of infection has been reported from 16 of the 32 Mexican states.

Transmission

Porcine rubulavirus seems to be spread mainly by the respiratory route. Direct contact is not required for transmission, and aerosols are thought to be significant. Infectious virus has also been found in urine and semen, and the virus can be transmitted to the fetus *in utero*.

In recovered pigs, porcine rubulavirus has been isolated intermittently from semen for up to 7 weeks after experimental inoculation, and from the testes and epididymis for as long as 20 weeks. Viral RNA was occasionally detected in semen samples during the latter period. No infectious virus has ever been isolated from other tissues in pigs after recovery from the acute illness; however, viral RNA was found in numerous organs, tissues and cells (including peripheral blood mononuclear cells) for as long as 13 months, and intermittently in serum for 2 months. In one study, viral RNA was also recovered from the internal organs of sentinel pigs that had been co-housed with recovered pigs for at least 4 months. None of the sentinel pigs developed clinical signs or antibodies to the virus, and live virus could not be recovered.

Paramyxoviruses are readily destroyed by light, heat and drying, and they are normally short-lived in the environment. However, a recent study found that an avian paramyxovirus persisted in distilled water for prolonged periods, especially at 4°C.

Disinfection

The disinfectant susceptibility of porcine rubulavirus has not been published, but members of the Paramyxoviridae are usually susceptible to many different agents including sodium hypochlorite, sodium hydroxide, aldehydes (e.g., glutaraldehyde, formalin), iodine, chlorhexidine, detergents, oxidizing agents and low pH.

Incubation Period

Experimentally infected piglets developed clinical signs after 3 to 5 days.

Porcine Rubulavirus Infection

Clinical Signs

In suckling piglets < 3 weeks of age, blue eye disease is characterized mainly by encephalitis and pneumonia. Typically, the illness begins with the sudden onset of nonspecific systemic signs (fever, depression, anorexia, prostration), followed by progressive neurological signs that may include ataxia, muscle tremors, abnormal posture, rigidity primarily affecting the hind legs and hyperexcitability. Some piglets may have a nasal discharge, dyspnea, constipation and/or diarrhea. Approximately 1-10% develop unilateral or bilateral corneal opacity, characterized by anterior uveitis and corneal edema. Piglets may also have other ocular signs, including conjunctivitis, nystagmus and apparent blindness. The fatality rate is usually high, especially in animals < 2 weeks of age, with some piglets dying within 48 hours of the initial signs.

Young pigs that are more than 30 days old usually develop a mild to moderate respiratory illness, with signs that may include fever, anorexia, coughing, sneezing and conjunctivitis. Corneal opacity may be seen in some animals. Neurological signs are uncommon in this age group, but have been reported in some outbreaks. They ranged from relatively mild signs (e.g., occasional depression, ataxia, circling or swaying of the head) to severe neurological disease.

Older pigs typically develop reproductive failure. Common reproductive signs in sows include decreased conception rates, abortions, increased stillbirths and mummified fetuses. Epididymitis, orchitis, and temporary or permanent reductions in semen quality can be seen in boars. Some adult pigs do not seem to have systemic signs, but fever, mild anorexia, conjunctivitis, constipation and/or corneal opacity have been reported in others. Neurological signs seem to be uncommon, but they have been described in a few outbreaks.

Post Mortem Lesions

The typical lesions in suckling pigs are interstitial pneumonia and non-suppurative encephalomyelitis. Gross lesions may include signs of multifocal lobular pneumonia (mainly in the anterior and ventral lobes), congestion in the brain, and conjunctivitis and chemosis in the eye. The peritoneal cavity sometimes contains a small amount of fluid with fibrin. Severe epididymo-orchitis is the primary lesion in most boars. The testes may be atrophied. Lesions reported in experimentally infected gilts included focal congestion and hemorrhages in the placenta and endometrium. Fetuses may be dehydrated or mummified, or smaller than normal with dermal ecchymoses. Abnormal fetuses are interspersed randomly with normal fetuses.

Diagnostic Tests

Porcine rubulavirus can be isolated from nasal and oral secretions in acutely affected animals, and from semen samples in boars. It may also be found in the blood. At

necropsy, this virus can be recovered consistently from the brain and tonsils of piglets, and sometimes from other organs including the lungs, spleen, liver, kidney and retropharyngeal lymph nodes. It was detected in the lungs, tonsils, placenta, reproductive organs and lymph nodes of experimentally infected gilts. Porcine rubulavirus can be isolated in pig kidney cell line (PK-15) cultures, other pig cell lines and primary cultures, baby hamster kidney cells (BHK 21), Vero cells and chick embryos. PK-15 and Vero cells are reported to be used most often in Mexico. A rapid diagnostic test, which uses immunostaining to detect viral antigens in impression smears (e.g., lung, midbrain or olfactory bulb), has also been described. RT-PCR assays have been developed, although they seem to be mainly used in research at present.

Most clinical cases in Mexico are diagnosed by serology. Tests that may be available include hemagglutination inhibition, virus neutralization, indirect immunofluorescence and enzyme-linked immunosorbent assays (ELISAs). Hemagglutination inhibition is reported to be the most commonly used diagnostic test in Mexico. Widespread seroprevalence is likely to complicate serological diagnosis unless rising titers are employed.

Treatment

There is no treatment for blue eye disease, other than supportive care.

Control

Disease reporting

Veterinarians who encounter or suspect porcine rubulavirus infection should follow their national and/or local guidelines for disease reporting. In the U.S., state or federal veterinary authorities should be informed immediately of any livestock disease suspected to be exotic.

Prevention

There is little or no information about measures being used to control porcine rubulavirus in Mexico. As with any contagious viral disease, quarantines, movement controls and other biosecurity measures would be needed to stop its spread. Quarantining new additions to a herd is likely to be helpful for uninfected herds in endemic regions; however, there is little information about how this virus spreads from herd to herd. The presence of nucleic acids in the tissues of recovered pigs and contact sentinel pigs raises concerns about the possibility of persistent infections, although no infectious virus has been recovered from convalescent pigs (except from semen up to 7 weeks). Artificial insemination may be a concern unless semen samples are tested.

At least one commercial inactivated vaccine is available in Mexico. There are no publications describing its efficacy.

Porcine Rubulavirus Infection

Morbidity and Mortality

Porcine rubulavirus is reported to be common in Mexico; up to 20-40% of pigs are seropositive in some areas. Outbreaks can be seen throughout the year, but they are most common from April to July. Most acute outbreaks in naive herds appear to be self-limiting, with the mortality rate usually rising and falling within 2-9 weeks. However, the virus may continue to be maintained on the farm after its introduction.

In commercial breeding operations, the disease is usually noticed first in the farrowing unit, where large numbers of young piglets may die from encephalitis. Typically, 20-60% of the litters are affected, with an overall morbidity rate of 20-50%. Piglets are most severely affected during the first 3 weeks of life, especially during the first 2 weeks. In fully susceptible litters, 90-100% of the piglets may die during the first few days of life, with mortality rates falling in older piglets. Infections in weaned animals are often mild. On most farms, the morbidity rate in young pigs > 30 days of age is approximately 1-4%, and mortality is low or absent. Blue eye disease does not usually cause significant systemic illness in adult sows and boars, but reproductive losses are common. A decrease in the conception rate can persist for 6-8 months.

More severe outbreaks have been reported occasionally, with neurological signs in weaned and growing pigs and/ or adults. In 2000-2003, outbreaks on a number of farms were characterized by a 30% increase in mortality among growing pigs and > 15% increased mortality in adult breeding females. Some viruses from recent outbreaks appear to differ genetically from older strains, and some authors speculate that certain genotypes may be associated with unusually severe outbreaks. However, other factors, such as poor nutrition and co-infections, could also be involved. One recent experiment compared older and newer strains in young piglets, and found that a virus from 1984 was at least as virulent as a strain isolated in 2013, and more virulent than another recent strain. Comparative studies have not yet examined the viruses isolated from unusually severe outbreaks.

Internet Resources

Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food, Government of Mexico
<http://www.sagarpa.gob.mx/English/Pages/Introduction.aspx>

United States Department of Agriculture, Animal and Plant Health Inspection Service
<https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/>

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

Acknowledgements

This factsheet was written by Anna Rovid-Spickler, DVM, PhD, Veterinary Specialist from the Center for Food Security and Public Health. The U.S. Department of Agriculture Animal and Plant Health Inspection Service (USDA APHIS) provided funding for this factsheet through a series of cooperative agreements related to the development of resources for initial accreditation training.

The following format can be used to cite this factsheet. Spickler, Anna Rovid. 2017. *Porcine Rubulavirus Infection*. Retrieved from <http://www.cfsph.iastate.edu/DiseaseInfo/factsheets.php>.

References

- Allan GM, McNeilly F, Walker I, Linne T, Moreno-Lopez J, Hernandez P, Kennedy S, Carroll BP, Herron B, Foster JC, Adair B. A sequential study of experimental porcine paramyxovirus (LPMV) infection of pigs: immunostaining of cryostat sections and virus isolation. *J Vet Diagn Invest.* 1996;8(4):405-13.
- Amivec S.A. Innovac@Ojo Azul.
<http://www.avimex.com.mx/new/content/es/swine/p-swine-v.html>. Accessed 13 Mar 2017.
- Cuevas JS, Rodríguez-Ropón A, Kennedy S, Moreno-López J, Berg M, Hernández-Jáuregui P. Investigation of T-cell responses and viral mRNA persistence in lymph nodes of pigs infected with porcine rubulavirus. *Vet Immunol Immunopathol.* 2009;127(1-2):148-52.
- Cuevas-Romero JS, Blomström AL, Berg M. Molecular and epidemiological studies of porcine rubulavirus infection - an overview. *Infect Ecol Epidemiol.* 2015;5:29602
- Cuevas-Romero S, Blomström AL, Alvarado A, Hernández-Jáuregui P, Rivera-Benitez F, Ramírez-Mendoza H, Berg M. Development of a real-time RT-PCR method for detection of porcine rubulavirus (PoRV-LPMV). *J Virol Methods.* 2013;189(1):1-6.
- Cuevas-Romero S, Hernández-Baumgarten E, Kennedy S, Hernández-Jáuregui P, Berg M, Moreno-López J. Long-term RNA persistence of porcine rubulavirus (PorPV-LPMV) after an outbreak of a natural infection: the detection of viral mRNA in sentinel pigs suggests viral transmission. *Virus Res.* 2014;188:155-61.
- Cuevas-Romero S, Rivera-Benítez JF, Blomström AL, Ramliden M, Hernández-Baumgarten E, Hernández-Jáuregui P, Ramírez-Mendoza H, Berg M. Molecular characterisation of porcine rubulavirus (PorPV) isolates from different outbreaks in Mexico. *Virus Genes.* 2016;52(1):81-90.
- Davis-Fields MK1, Allison AB, Brown JR, Poulson RL, Stallknecht DE. Effects of temperature and pH on the persistence of avian paramyxovirus-1 in water. *J Wildl Dis.* 2014;50(4):998-1000.

Porcine Rubulavirus Infection

- Department of Agriculture, Fisheries and Forestry [DAFF], Government of Australia. Generic import risk analysis (IRA) for uncooked pig meat [monograph online]. Issues Paper. DAFF; 2001 Jan. Available at: http://www.affa.gov.au/corporate_docs/publications/word/mark_access/biosecurity/animal/2001/2001-02a.doc. * Accessed 12 Dec 2005.
- Enders G. Paramyxoviruses In: Baron S, editor. Medical microbiology [online]. 4th ed. New York: Churchill Livingstone; 1996. Available at: <https://www.ncbi.nlm.nih.gov/books/NBK8461/>. Accessed 13 Mar 2017.
- Escobar-López AC, Rivera-Benitez JF, Castillo-Juárez H, Ramírez-Mendoza H, Trujillo-Ortega ME, Sánchez-Betancourt JI. Identification of antigenic variants of the porcine rubulavirus in sera of field swine and their seroprevalence. *Transbound Emerg Dis*. 2012;59(5):416-20.
- García-Barrera AA, Del Valle A, Montaña-Hirose JA, Barrón BL, Salinas-Trujano J, Torres-Flores J. Full-genome sequencing and phylogenetic analysis of four neurovirulent Mexican isolates of porcine rubulavirus. *Arch Virol*. 2017 [Epub ahead of print].
- Geering WA, Penrith M-L, Nyakahuma D. Manual on procedures for disease eradication by stamping out. Part 3: Decontamination procedures. Food and Agriculture Organization of the United Nations; 2001. Available at: <http://www.fao.org/docrep/004/Y0660E/Y0660E03.htm>. Accessed 13 Mar 2017.
- Hernandez-Jauregui P, Ramirez Mendoza H, Mercado Garcia C, Moreno-Lopez J, Kennedy S. Experimental porcine rubulavirus (La Piedad-Michoacan virus) infection in pregnant gilts. *J Comp Pathol*. 2004;130(1):1-6.
- Herrera J, Gómez-Núñez L, Lara-Romero R, Diosdado F, Martínez-Lara A, Jasso M, Ramírez-Mendoza H, Pérez-Torres A, Rivera-Benitez JF. Acute neurologic disease in porcine rubulavirus experimentally infected piglets. *Virus Res*. 2017;230:50-58.
- International Committee on Taxonomy of Viruses [ICTV]. Virus Taxonomy: 2015 Release EC 47, London, UK, July 2015; Email ratification 2016 (MSL #30). Paramyxoviridae. ICTV; 2016. Available at: <http://www.ictvonline.org/>. Accessed 10 Mar 2016.
- Kawana R1, Kitamura T, Nakagomi O, Matsumoto I, Arita M, Yoshihara N, Yanagi K, Yamada A, Morita O, Yoshida Y, Furuya Y, Chiba S. Inactivation of human viruses by povidone-iodine in comparison with other antiseptics. *Dermatology*. 1997;195 Suppl 2:29-35.
- McNeilly F, Walker I, Allan GM, Foster JC, Linne T, Merza M, Hernandez P, Kennedy S, Adair B. A comparative study on the use of virus and antibody detection techniques for the diagnosis of La Piedad Michoacan paramyxovirus (LPMV) infection in pigs. *J Vet Diagn Invest*. 1997;9(1):3-9.
- Nordengrahn A, Svenda M, Moreno-Lopez J, Bergvall A, Hernandez P, McNeilly F, Allan G, Merza M. Development of a blocking ELISA for screening antibodies to porcine rubulavirus, La Piedad Michoacan Virus. *J Vet Diagn Invest*. 1999;11(4):319-23.
- Ramirez-Mendoza H, Hernandez-Jauregui P, Reyes-Leyva J, Zenteno E, Moreno-Lopez J, Kennedy S. Lesions in the reproductive tract of boars experimentally infected with porcine rubulavirus. *J Comp Pathol*. 1997;117(3):237-52.
- Rivera-Benitez JF, Cuevas-Romero S, Pérez-Torres A, Reyes-Leyva J, Hernández J, Ramírez-Mendoza H. Respiratory disease in growing pigs after porcine rubulavirus experimental infection. *Virus Res*. 2013;176(1-2):137-43.
- Rivera-Benitez JF, García-Contreras Adel C, Reyes-Leyva J, Hernández J, Sánchez-Betancourt JI, Ramírez-Mendoza H. Efficacy of quantitative RT-PCR for detection of the nucleoprotein gene from different porcine rubulavirus strains. *Arch Virol*. 2013;158(9):1849-56.
- Rivera-Benitez JF, Martínez-Bautista R, Pérez-Torres A, García-Contreras Adel C, Reyes-Leyva J, Hernández J, Ramírez-Mendoza H. Persistence of porcine rubulavirus in experimentally infected boars. *Vet Microbiol*. 2013;162(2-4):491-8.
- Rivera-Benitez JF, Rosas-Estrada K, Pulido-Camarillo E, de la Peña-Moctezuma A, Castillo-Juárez H, Ramírez-Mendoza H. Serological survey of veterinarians to assess the zoonotic potential of three emerging swine diseases in Mexico. *Zoonoses Public Health*. 2014;61(2):131-7.
- Sánchez-Betancourt JI, Santos-López G, Alonso R, Dopporto JM, Ramírez-Mendoza H, Mendoza S, Hernández J, Reyes-Leyva J, Trujillo ME. Molecular characterization of the hemagglutinin-neuraminidase gene of porcine rubulavirus isolates associated with neurological disorders in fattening and adult pigs. *Res Vet Sci*. 2008;85(2):359-67.
- Solís M, Ramírez-Mendoza H, Mercado C, Espinosa S, Vallejo V, Reyes-Leyva J, Hernández J. Semen alterations in porcine rubulavirus-infected boars are related to viral excretion and have implications for artificial insemination. *Res Vet Sci*. 2007;83(3):403-9.
- Stephan HA, Gay GM, Ramirez TC. Encephalomyelitis, reproductive failure and corneal opacity (blue eye) in pigs, associated with a paramyxovirus infection. *Vet Rec*. 1988;122(1):6-10.
- Wiman AC, Hjertner B, Linne T, Herron B, Allan G, McNeilly F, Adair B, Moreno-Lopez J, Berg M. Porcine rubulavirus LPMV RNA persists in the central nervous system of pigs after recovery from acute infection. *J Neurovirol*. 1998;4(5):545-52.

* Link is defunct