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Aujeszky's Disease

Pseudorabies, Mad Itch

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Overview

- Organism
- Economic Impact
- Epidemiology
- Transmission
- Clinical Signs
- Diagnosis and Treatment
- Prevention and Control
- Actions to Take

In today's presentation we will cover information regarding the organism that causes Aujeszky's disease and its epidemiology. We will also talk about the economic impact the disease has had in the past and could have in the future. Additionally, we will talk about how it is transmitted, the species it affects, clinical signs and necropsy findings, and diagnosis and treatment of the disease. Finally, we will address prevention and control measures for the disease, as well as actions to take if Aujeszky's disease is suspected.

[This photo shows a swine herd. Source: Dr. Alex Ramirez, Iowa State University, College of Veterinary Medicine]

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THE ORGANISM

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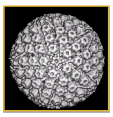
Aujeszky's Disease Virus

- Alphaherpesvirus
  - Genus: *Varicellovirus*
  - Single serotype
- Highly contagious
- Natural hosts
  - Domestic and feral swine
    - Can become latent carriers
  - Most mammals are susceptible



Aujeszky's disease results from infection by Aujeszky's disease virus (ADV), also known as pseudorabies virus. This virus is a member of the genus *Varicellovirus*, subfamily Alphaherpesvirinae, and family Herpesviridae. Only a single serotype is known; however, strain differences have been recognized using molecular techniques. Pigs are the natural host for Aujeszky's disease virus and the only animals to become latent carriers. However, the virus can infect nearly all domesticated and wild mammals including cattle, sheep, goats, cats and dogs.

[Photo: Cryo-electron microscopy of herpesvirus from the Institute of Molecular Virology at the University of Wisconsin via http://www.virology.net/big_virology/bvdnaherpes.html#alpha]

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IMPORTANCE

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History

- 1902, Hungary
  - Aujeszky first identifies ADV in cattle and dogs
  - Determines swine are natural hosts
- 1931, U.S.
  - "Mad itch" recognized as Aujeszky's disease
- 1983, U.S.
  - 18.8% U.S. breeding swine seropositive

Aladar Aujeszky, a Hungarian veterinarian, first recognized pseudorabies as a disease of cattle and dogs in 1902. It soon became evident, however, that swine were the natural hosts of the virus, and pigs could die as a result of the disease. Hanson described a disease in the U.S. in 1813 which resembles Aujeszky's disease, but it was only in 1931 that Shope identified "mad-itch," as it was known in the U.S., as Aujeszky's disease. For years in Europe, pseudorabies has been recognized as an important cause of abortions and death in swine. Until the late 1960s and the early 1970s, the disease in the U.S. was considered important only as a cause of death in baby pigs and occasionally in cattle, sheep, dogs, and cats. However, the present viruses are capable of causing a variety of clinical manifestations, including death in newborn and adult swine and fetal death with abortion in pregnant swine. The disease was widespread and of considerable economic importance in several Midwestern states. A slaughter serum survey conducted in 1983 revealed a nationwide prevalence of 18.8% in breeding swine with state rates ranging from 0% to 34.3%.

[This is a photo of Aladar Aujeszky. Source: http://en.wikipedia.org/wiki/Alad%C3%A1r_Aujeszky]

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Pseudorabies Eradication

- 1989
  - National Pseudorabies Eradication Program implemented
    - USDA-APHIS, States and producers
    - Over 8000 herds identified
- 2004
  - U.S. commercial swine herds declared pseudorabies free
  - Still present in feral swine

In the U.S., in 1989, the U.S. Department of Agriculture, Animal and Plant Health Inspection Service (USDA-APHIS) launched a national pseudorabies eradication program, in cooperation with State governments and swine producers. The program involved systematic identification of pseudorabies infected swine and management (test and slaughter, vaccination, depopulation) to eliminate sources of the disease. At that time over 8000 swine herds were identified with pseudorabies. Following these measures, by 1992, little over 1000 infected herds remained. In 2004, pseudorabies was successfully eradicated from commercial swine herds. It is still found in feral swine in the U.S. Monitoring and testing of transitional herds (any herds with exposure to feral or wild pigs) continues.

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Economic Impact

- Trade restrictions
- 1988 study – U.S. epizootic
  - Newborn pig mortality
    - 76.5% of total net losses (TNL)
    - Estimated $24/inventoried sow/week
  - Nursery pig mortality (12.6% TNL)
  - Sow culling and deaths (9.4% TNL)

Aujeszky's disease can result in trade restrictions from regions where it is endemic. Eradication programs are underway or have been successful in many countries. In a study conducted in 1988 on the economic impact of pseudorabies epizootic in the U.S., the major economic losses were due to newborn pig mortality (76.5% of total net loses at an estimated $24/inventoried sow/week). Nursery pig mortality followed with 12.6% of total net losses; sow culling and deaths accounted for 9.4% or the total net losses.

[Source: Bech-Nielsen S, Miller GY, Bowman GL, et al. J Am Vet Med Assoc. 1992 Jun 15;200(12):1817-23.]

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EPIDEMIOLOGY

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Geographic Distribution

- Europe, Southeast Asia, Central and South America
- Other reports
  - Cuba, Samoa, Rwanda
- All U.S. states are status V (pseudorabies free)
- Presence of ADV in feral swine a concern for domestic herds

Aujeszky's disease can be found in parts of Europe, Southeast Asia, and Central and South America including Mexico. The virus has also been reported from Cuba, Samoa and Rwanda. Until recently, Aujeszky's disease was endemic in the United States; however, a successful eradication campaign has eliminated the virus from domesticated swine. A surveillance program is now ongoing, and currently, all states are classified as status V (free). Aujeszky's disease virus remains present in feral pigs in the U.S., which is a concern for transmission to domesticated herds. Aujeszky's disease has also been eradicated from domesticated swine in a number of European countries, as well as Canada and New Zealand. Additional countries are conducting eradication programs.

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Morbidity/Mortality

- Disease most common in pigs
- Morbidity
  - Up to 100%
  - Up to 20% abortions
  - Often no signs in feral pigs
- Mortality
  - Highest in younger animals
  - Decreases with age
  - Always fatal in other species

Aujeszky's disease is most common in pigs. Up to 100% of the pigs in a herd may become infected. The mortality rate is highest in newborn piglets (up to 100%) and nursing pigs (up to 50%) with death rate decreasing with increasing age; it may be as low as 1 to 2% in grower and finisher pigs, 5-10% in weaner pigs. Approximately 20% or fewer sows abort. Feral swine tend to become infected with attenuated strains as adults, and both illness and deaths are usually absent. Sporadic cases occur in other species in close contact with pigs. In these species, Aujeszky's disease is always fatal.

[This photo shows piglets. Source: www-geograph-org-uk-creative-commons.jpg]

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TRANSMISSION

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Transmission: Pigs

- Most common
  - Respiratory
  - Oral
  - Nose-to-nose contact
- Aerosol
- Fomites
  - Contaminated bedding and water
  - Meat products or carcasses
- Venereal – feral swine
- Latent carriers possible

Aujeszky's disease virus is usually transmitted between pigs by the respiratory or oral routes. It is often spread directly between animals by nose-to-nose transmission; however, the virus can remain infectious for as long as seven hours in the air, if the relative humidity is at least 55%, and it may travel up to two kilometers as an aerosol. It can also be transmitted on fomites and in carcasses. Under favorable conditions, ADV can survive for several days in contaminated bedding and water. Venereal transmission is possible, and may be the most important method of spread in wild pigs. Piglets can be infected transplacentally. Infected pigs can become latent carriers of ADV. The inactive virus is carried in the trigeminal ganglia in domesticated swine, and can become reactivated after stressors including transport, crowding, corticosteroid injections or farrowing. Latent virus has also been reported in the tonsils; however, it is uncertain whether the virus is truly latent at this site, or the tonsils are persistently infected at low levels. In feral swine, latent virus is found mainly in the sacral ganglia. Once the Aujeszky's disease virus has entered a herd or population, it continues to circulate indefinitely unless an eradication campaign is conducted.

[This photo shows piglets. Source: Ken Hammond, USDA On-line Photography]

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Transmission: Other Species

- Contact with infected pigs
- Ingestion of contaminated raw meat
- Rarely lateral transmission

Other animals usually become infected through close contact with infected pigs. Carnivores or omnivores have been infected after ingesting contaminated raw meat. Most species are dead-end hosts, but sheep and cattle may occasionally excrete some virus; rare lateral transmission has been reported in these species.

[These photos show other species susceptible to Aujeszky's Disease. Cat from www.publicdomainimage.com; cow from Alice Welch/U.S. Department of Agriculture; sheep from www.flickr-creative-commons; dog from pixabay-com-public-domain

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ANIMALS AND AUJESZKY'S DISEASE

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Clinical Signs: Pigs

- Incubation period: 2 to 6 days
- < 1 week old piglets
  - Fever, listlessness, anorexia
  - Neurological signs
    - Tremors, paddling, seizures, dog-sitting
  - High mortality within 24 to 36 hours
- Older piglets
  - Similar signs
    - Vomiting and respiratory
  - Lower mortality

The incubation period is usually 2-4 days in suckling pigs, and 3-6 days in weaned or adult pigs. In pigs, the clinical signs vary with the age of the animal. In piglets less than a week old, fever, listlessness, and anorexia are quickly followed by tremors, paddling, seizures, or other signs of neurological involvement. Some piglets with hind leg paralysis may sit on their haunches in a "dog-like" position. Others may become recumbent and paddle, or walk in circles. Some piglets may die within hours with no symptoms. Mortality in this age group is very high; once neurologic signs develop, the piglets usually die within 24-36 hours. Similar signs also occur in slightly older piglets, but the mortality rate is lower. Vomiting and respiratory signs have also been reported in this age group.

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Clinical Signs: Pigs

- Weaned pigs
  - Respiratory and
  - neurological signs
  - Recover in 5 to 10 days
- Adult pigs
  - Mild or inapparent infection
  - Respiratory and neurological signs
  - Pregnant sows: reproductive signs
- Feral swine often asymptomatic

In weaned pigs, Aujeszky's disease is mainly a respiratory illness. Signs include fever, anorexia, weight loss, coughing, sneezing, conjunctivitis, and dyspnea. Respiratory disease may be complicated by secondary bacterial infections. Neurological signs are occasionally seen. Weaned pigs tend to recover after 5-10 days. In adults, the infection is usually mild or inapparent, with respiratory symptoms predominating. Some adult pigs may develop more severe respiratory signs that can progress to pneumonia. In sporadic cases, neurologic signs that vary in severity from mild muscle tremors to convulsions can occur. Pregnant sows may resorb infected fetuses, abort, or give birth to weak, trembling neonates; a litter can contain a mixture of normal piglets, stillborn piglets, and weak piglets. Infections in feral swine tend to be asymptomatic, as these animals appear to be infected with attenuated viruses and are typically infected as adults.

[This phot shows two feral swine. Source: www-public-domain-image-com]

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Clinical Signs: Other Species

- Cattle and sheep
  - Intense pruritus
    - Licking, rubbing, gnawing, self-mutilation
  - Neurological signs
- Dogs and cats
  - Similar to cattle and sheep
  - Resembles rabies
- Death in 1 to 2 days

In cattle and sheep, Aujeszky's disease is almost always fatal within a few days. The first symptom is intense pruritus concentrated in a patch of skin; this is usually manifested as severe licking, rubbing, or gnawing. Self–mutilation is common. Affected animals become progressively weaker and, eventually, recumbent. Convulsions, bellowing, teeth grinding, cardiac irregularities, and rapid, shallow breathing are common. The clinical signs are similar in dogs and cats, and a combination of neurologic signs, pharyngeal paralysis, and profuse salivation may resemble rabies. Affected animals typically die within 1-2 days. [The photo shows a calf with Aujeszky's disease, licking a pruritic area. Source: www.vetmed.uni-muenchen.de/med2/skripten/b8-5.html]

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Post Mortem Lesions

- Lesions often subtle or absent
- Serous or fibrinonecrotic rhinitis
- Pulmonary edema, congestion, consolidation
- Congested and hemorrhagic lymph nodes
- Necrotic foci in other organs

In pigs, post mortem lesions are often subtle, absent, or difficult to find. Many pigs have serous or fibrinonecrotic rhinitis (see photo), but this may be visible only if the head is split and the nasal cavity opened. Pulmonary edema, congestion, or consolidation are sometimes found, and secondary bacterial pneumonia can result in more obvious gross lesions. The lymph nodes may be congested and contain small hemorrhages. Affected pigs may have necrotic tonsillitis or pharyngitis, congested meninges, or necrotic placentitis. Necrotic foci can also occur in the liver, particularly in very young piglets.

[Photo: Pseudorabies rhinitis. Dr. Pat Halbur, Iowa State University and the American Association of Swine Veterinarians].

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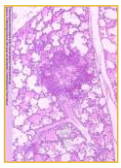
Microscopic Lesions

- Pigs
  - Neurological
    - Nonsuppurative meningoencephalitis
  - Respiratory
    - Necrotic tonsillitis, bronchitis, bronchiolitis, alveolitis
  - Focal necrosis
- Other species
  - Spinal cord lesions



Microscopic examination of the white and gray matter typically reveals nonsuppurative meningoencephalitis. Mononuclear perivascular cuffing and neuronal necrosis may be seen, and the meninges are usually thickened from mononuclear cell infiltration. Additional microscopic findings may include necrotic tonsillitis, bronchitis, bronchiolitis, and alveolitis. Focal necrosis is common in the liver, spleen, adrenal glands, and lymph nodes of affected fetuses. In species other than pigs, the only lesions may be areas of edema, congestion, and hemorrhage in the spinal cord. These lesions are usually found in the portion of the spinal cord that innervates the area of pruritus. Microscopically, there is cellular infiltration and neuronal degeneration. CNS lesions similar to those found in pigs, but milder, are often found.

[Photo: Histopathology of pneumonia associated with pseudorabies. Dr. Pat Halbur, Iowa State University and the American Association of Swine Veterinarians.]

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Differential Diagnosis

- Pigs
  - Porcine polioencephalomyelitis
  - Classical or African swine fever
  - Hemagglutinating encephalomyelitis infection
  - Streptococcal meningoencephalitis
  - Swine influenza
  - Erysipelas
  - Nipah virus infection
  - Salt or organic poisoning
- Other species
  - Rabies
  - Scrapie in sheep

In pigs, the differential diagnosis includes porcine polioencephalomyelitis, classical or African swine fever, hemagglutinating encephalomyelitis infection, streptococcal meningoencephalitis, swine influenza, erysipelas, Nipah virus infection, salt poisoning, hypoglycemia, poisoning by organic arsenic or mercury, and congenital tremor. Diseases that result in abortions may also need to be ruled out. In species other than pigs, rabies and scrapie must be considered.

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Diagnosis: Laboratory

- Clinical signs suggestive
- Virus isolation
- Detection of viral DNA or antigens
  - Immunofluorescence, immunoperoxidase, virus neutralization assays, PCR
- Serology
  - Virus neutralization, latex agglutination, ELISAs

Aujeszky's disease should be suspected in pig herds with high mortality and CNS symptoms in young piglets, and lower mortality and respiratory signs in older animals. In other species, it should be suspected when sudden death, intense pruritus and neurological signs are present. Aujeszky's disease can be diagnosed by virus isolation, detection of viral DNA or antigens, and serology. The Aujeszky's disease virus can be isolated on a number of cell lines; porcine kidney (PK–15) cells are most often used. This virus can be identified in cultures using immunofluorescence, immunoperoxidase, or virus neutralization assays. Latent virus can be difficult to find. Alternatively, polymerase chain reaction (PCR) assays can identify viral DNA in secretions or organ samples. A fluorescent antibody test can detect viral antigens in tissue samples and nasal swabs. Serologic tests for

Aujeszky's disease include virus neutralization, latex agglutination, and enzyme–linked immunosorbent assays (ELISAs). ELISAs and virus neutralization are the prescribed tests for international trade. ELISAs can distinguish vaccinated from infected pigs, if gene-deleted vaccines are used. Serology may not be helpful in species other than pigs; these animals often die before mounting an antibody response.

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AUJESZKY'S DISEASE IN HUMANS

Disease has not been reported in humans

The symptoms of pseudorabies have not been seen in humans; however, seroconversion does occur.

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PREVENTION AND CONTROL

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Recommended Actions

- IMMEDIATELY notify authorities
- Federal
  - Area Veterinarian in Charge (AVIC)
    www.aphis.usda.gov/animal_health/area_offices/
- State
  - State Animal Health Officials
    www.usaha.org/Portals/6/StateAnimalHealthOfficials.pdf
- Quarantine

If you suspect a case or outbreak of Aujeszky's Disease (pseudorabies), contact your state and/or federal veterinarian immediately and quarantine the premises. If Aujeszky's (pseudorabies) is detected in a non-endemic country, a strict quarantine zone should be established. The USDA-APHIS now requires that confirmed cases of pseudorabies in commercial production swine be reported immediately to Veterinary Services for action. Additionally, after a confirmed case is identified in commercial production swine, all movement of swine from herds within a five-mile radius of the case and from exposed herds must be stopped until such herds are tested and found to be negative using an official random sample test; and this testing must be completed within 15 days of identifying the infected herd.

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Quarantine and Disinfection

- Isolation and testing of new animals
- Biosecurity measures
  - Prevent entry
  - Double fencing
- Disinfection
  - Phenols, quaternary ammonium compounds
  - Inactivated by heat, sunlight

Prevention of pseudorabies is done by isolation and testing of new breeding animals and biosecurity measures to prevent entry (and/or spread) by fomites, people, and roaming animals, including rodents and birds. In addition, domesticated herds must be kept separate from feral swine by "double fencing." The pseudorabies virus is susceptible to some phenols and quaternary ammonium compounds and is inactivated by sunlight, drying, and high temperatures. [Top photo shows a farm entrance fenced off from Dr. Katie Steneroden, Iowa State University, College of Veterinary Medicine; bottom photo shows disinfecting equipment from Dr. Danelle Bickett-Weddle, Iowa State University, College of Veterinary Medicine]

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Prevention

- Depopulation and repopulation
  - Premises cleaned, disinfected
  - Left empty for 30 days
- Test and removal
  - Test breeding herd monthly
  - Remove positive animals
- Offspring segregation
  - Vaccinate breeding herd
  - Remove young weaned pigs

Aujeszky's disease can be controlled in a region by quarantine of infected herds, vaccination, and the removal of latently infected animals. Strategies to eradicate the disease from a herd include depopulation and repopulation, test and removal, and offspring segregation strategies. Depopulation and repopulation is the most drastic technique. The premises are cleaned, disinfected, and left empty of pigs for 30 days. In the test and removal strategy, the breeding herd is tested monthly, with the removal of animals that test positive. This technique works best when there is a relatively low prevalence of infection in the herd. This technique can be combined with vaccination. One difficulty with the test and removal strategy is that it may be difficult to detect latently infected animals. In the offspring segregation technique, the breeding herd is vaccinated, and young weaned piglets are removed and raised to adulthood at another site. These pigs are tested periodically, and any positive animals are removed. The original herd is eventually depopulated and replaced with Aujeszky's disease-free animals.

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Vaccination

- Protects pigs from clinical signs
- Decrease virus shedding
- Does not provide sterile immunity or prevent latent infections
- Attenuated, inactivated, gene-deleted vaccines
  - Vaccinated pigs which become infected can be detected

Vaccination can also aid in disease control. The currently available vaccines protect pigs from clinical signs and decrease virus shedding, but do not provide sterile immunity or prevent latent infections. Attenuated, inactivated, and gene-deleted marker vaccines are available; the gene-deleted vaccines allow vaccinated pigs to be distinguished from pigs infected with field viruses. DNA vaccines are in development.

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Additional Resources

- USDA-APHIS website
  - www.aphis.usda.gov
- World Organization for Animal Health (OIE) website
  - www.oie.int
- Center for Food Security and Public Health
  - www.cfsph.iastate.edu/DiseaseInfo/
- Food and Agriculture Organization of the United Nations (FAO) website
  - www.fao.org

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Acknowledgments

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