



Bihar Animal Sciences University



Course no. VMC 605
Systematic Animal Virology

Online lecture

Topic:

“Pseudorabies virus”

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Pseudorabies virus (PRV)

Aujeszky's disease


▪ Family : *Herpesviridae*

▪ Sub family :
Alphaherpesvirinae

▪ Genus:
Varicellovirus

▪ Species:
Porcine Herpesvirus 1



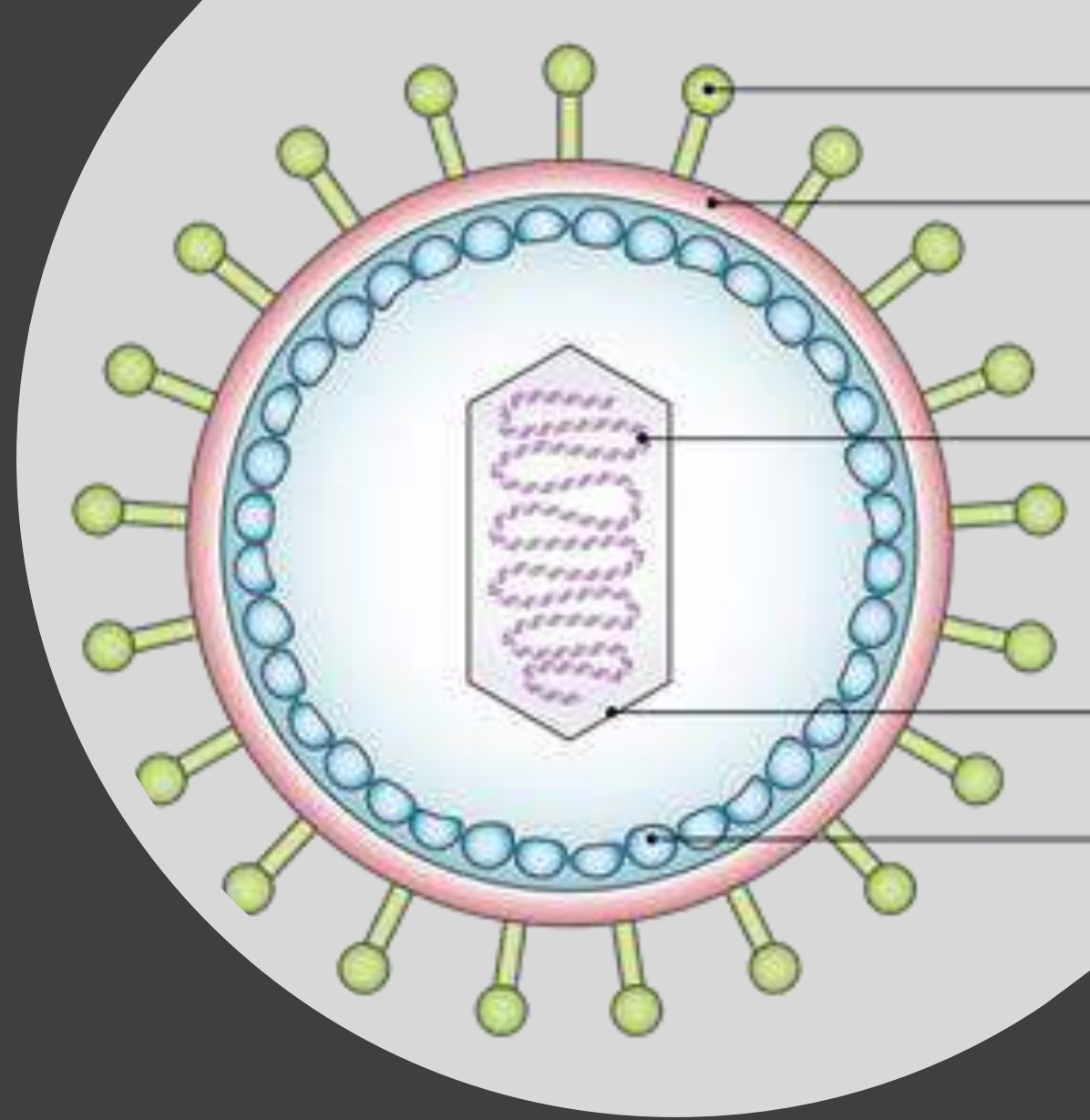


Pseudorabies virus (PRV) is a contagious herpesvirus that causes reproductive problems (abortion, stillbirths), respiratory problems and occasional deaths in breeding and finishing hogs.

Suid herpesvirus 1

(Syn : Porcine Herpesvirus 1 ; Aujeszky's Disease Virus)

- **Species:** Porcine Herpesvirus 1
 - Single serotype
 - *Su HV-1* is 150 – 180 nm sized virion
 - Composed of a 145 Kbp linear double - stranded DNA genome.
 - The 105 – 110 nm wide nucleocapsid
 - Sensitive to ether , chloroform, formaldehyde etc.
 - Inactivated at 37 °C





Suid herpesvirus 1

(Syn : Porcine Herpesvirus 1 ; Aujeszky's Disease Virus)

- **Species:** Porcine Herpesvirus 1

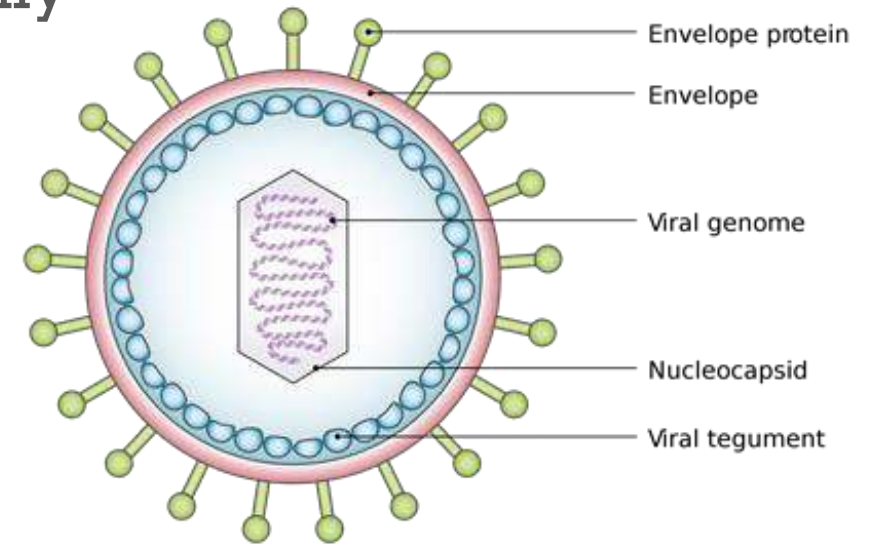
- Pseudorabies virus (PRV) is an enveloped, double-stranded DNA virus belonging to the family *Herpesviridae*.

- Single serotype

- Su HV-1 is 150 – 180 nm sized virion

- The 105 – 110 nm wide nucleocapsid

- Composed of a 145 Kbp linear double - stranded DNA genome.





Cleaning and Disinfection

- PRV is stable over a pH range of 4–12 and can remain infectious at cold temperatures for weeks.
- The virus is inactivated at high temperatures.
- PRV is reportedly susceptible to disinfectants including:
 - orthophenolphenate compounds
 - peracetic acid
 - formalin
 - 2% sodium hydroxide
 - trisodium phosphate iodide disinfectants
 - 1–2% quaternary ammonium compounds
 - Sodium hypochlorite (bleaching powder),
 - chlorhexidine.



■ **Cell Culture** –

- Rabbit testicle-
- Guinea pig testicle
- Swine testicle
- Mink lung (ML)
- Equine dermal (ED),
- Porcine kidney (PK15),
- Bovine turbinate (BT) cells

■ **Cytopathic effect (CPE)**

- cellular degenerative processes complete destruction of the cell monolayer, regions of rounded or fused cells surrounding clear, cell-free areas (plaques) and regions showing haemadsorption.

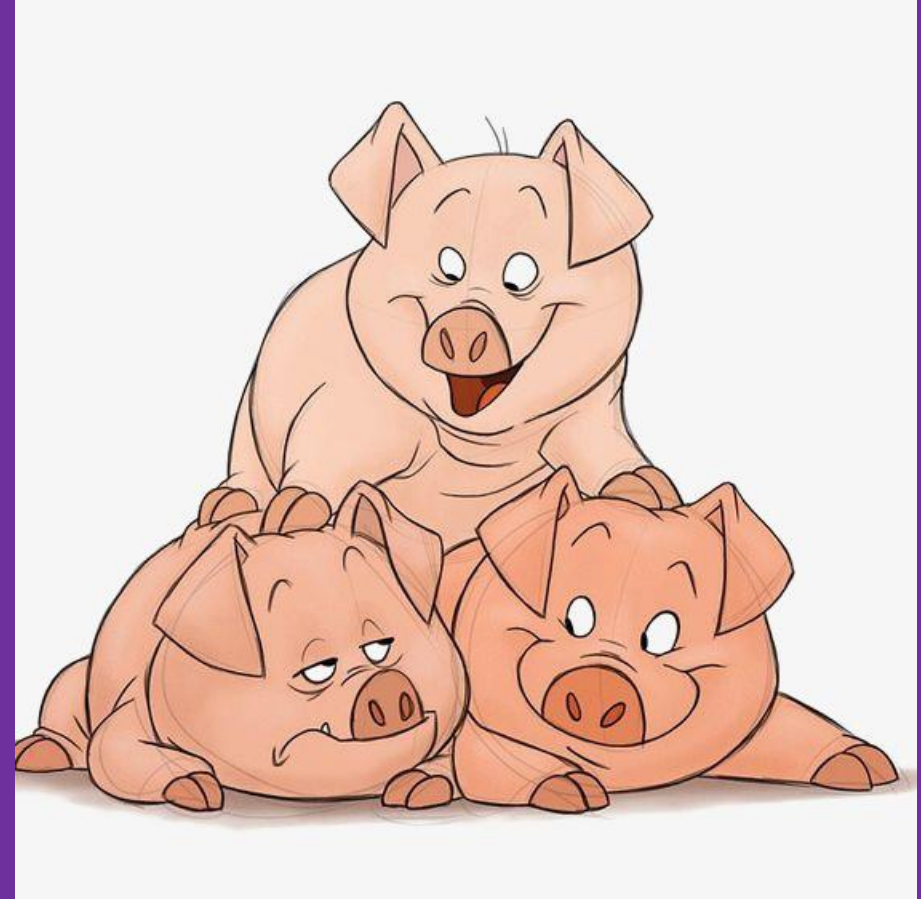
■ **Chicken embryo** - yolk sac method;

- the embryos dies after 3 days
- virus produce characteristic intranuclear inclusions in the yolk sac cells

Cultivation of Pseudorabies virus

The Disease

Pseudorabies /Aujeszky's Disease



History

- 1902
 - Aládar Aujeszky, Hungary
 - First identified in cattle and dogs
 - Determined swine were natural hosts
- 1931: “mad itch” same as Aujeszky’s disease



What is Pseudorabies?

- **Pseudorabies is a neurological disease of swine** can also affect cattle, dogs, cats, sheep, and goats. Infected new born pigs may exhibit central nervous system clinical signs.





Aujeszky's disease or pseudorabies or Mad itch (Historical background)

- Aujeszky 's disease (**PSEUDORABIES**), pseudorabies or ' **mad itch** '
 - neurological/respiratory disorder
 - affects a wide range of animals – pig, cattle, dogs, cats, sheep, and goats
- PRV was first described in cattle in the 1800s with '**mad-it**ch'
 - a syndrome marked by intense scratching and self-mutilation at the site of virus entry
 - Later the term pseudorabies was used.
- By the early 1900s, physician **Aladár Aujeszky** isolated the virus from cattle, dogs, and cats, and the disease became widely known as **Aujeszky's disease**



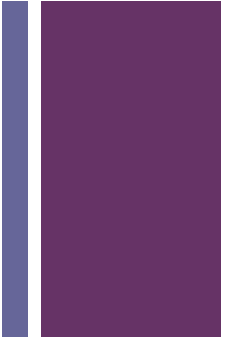


Aetiology



- Porcine or Suid herpesvirus type 1 (SuHV-1), also known as *pseudorabies virus (PRV)* or *Aujeszky ' s disease virus (ADV)*, which belongs to the family *Herpesviridae* in the genus *Varicellovirus* .
- Two strains of virus
 - 'Classical' PRV strains
 - 'Variant' PRV strains

+ 'Classical' PRV strains



Four genotypes

Type I (USA)

Types II and III (Central and North Europe),

Type IV (Asia)



Aujeszky's disease or pseudorabies or Mad itch

- **Susceptibility of the animal host**
 - **Pigs** are the **natural host** for Aujeszky's disease virus and the only animals to become **latent carriers**.
 - virus can infect nearly all **domesticated** and **wild mammals** including **cattle**, **sheep**, **goats**, **cats** and **dogs**.



Epidemiology



■ Geographic Distribution -

- 'Classical' strain is world wide with dense pig populations
- 'Variant' strain is reported from China in 2011
- Feral swine are a source of PRV in many areas, including those where the virus has been eradicated from domestic swine.

■ Morbidity and Mortality -

- High morbidity and mortality rates, particularly in suckling pigs.
- Up to 100% of piglets less than 1-week-old may die
- Variant strains can cause mortality rates up to 50%
- unlike classical strains, they also affect grower-finisher swine.

+ Sources of the virus

- The pigs considered as a true Su HV-1 reservoir, because the virus can infect, replicate and be excreted in this species, which is sufficiently abundant to be a wild reservoir.
- Other mammalian species are dead - end hosts in which death occurs before viral excretion.
- Large amounts of virus can be isolated from nasal and oropharyngeal swabs of infected pigs
- Virus is found in vaginal and foreskin (ejaculate) secretions ,in milk and irregularly in urine
- Additional virus sources for carnivores are SuHV-1-infected rats and mice.



Secretion and excretion from the source



- Su HV-1 is excreted in suids by
 - nasal exudates
 - saliva
 - vaginal mucus
 - sperm
 - milk
 - faeces
 - occasionally urine



Transmission

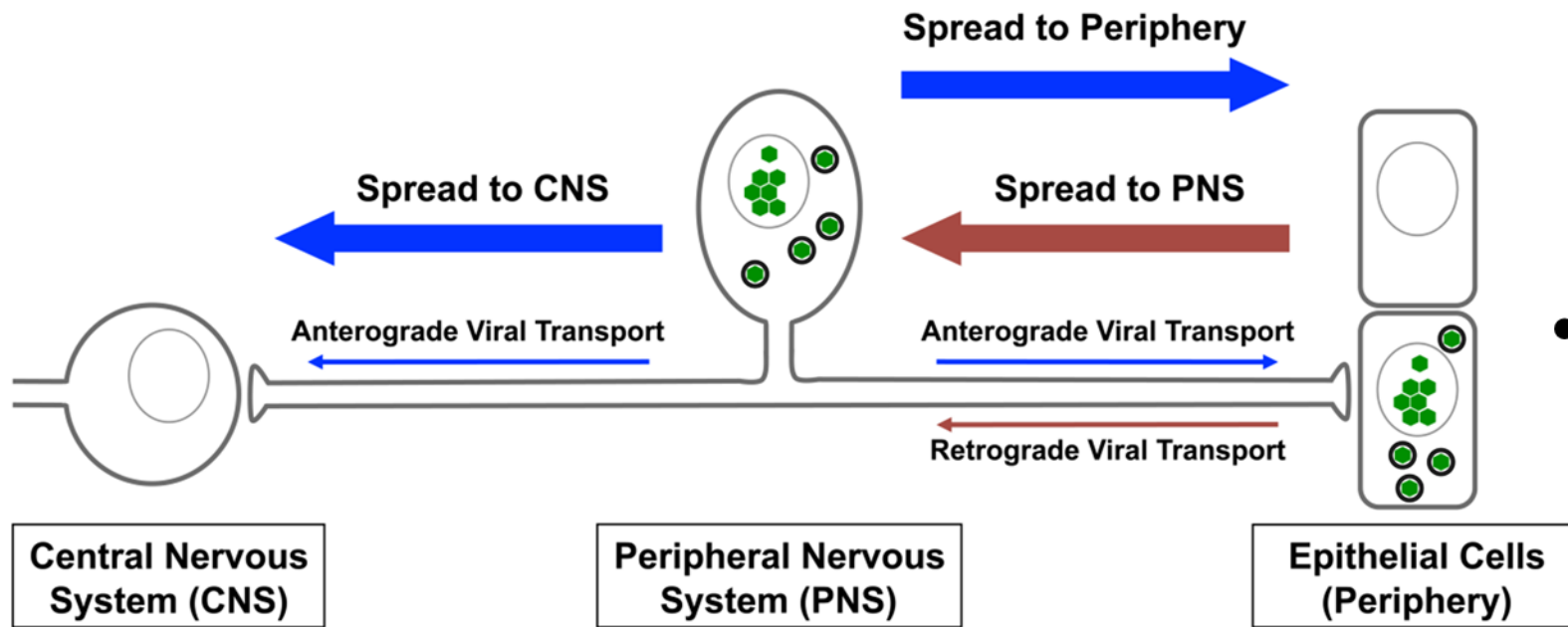


- Direct **oronasal contact** is the **main route of transmission** in domestic swine.
- Conjunctival transmission can also occur.
- **Pigs with latent infection**, showing no clinical signs, can **introduce the virus into susceptible herds**.
- PRV is transmitted vertically.
- Venereal transmission is considered to be the main route in feral swine.
- The virus is also transmitted by **air, water, and contaminated fomites**.
- Ingestion of infected meat or carcasses is linked to PRV transmission in dogs and cats, as well as free-ranging and captive wildlife.



Infection in Swine/Pathogenesis

- In latently infected pigs, PRV persists primarily in the trigeminal ganglia (the predominant site in domestic pigs), the sacral ganglia (the predominant site in wild pigs), and the tonsils.
- In domestic pigs, CNS signs are most common in suckling pigs, but sudden death can also occur.
- In older, growing pigs, respiratory signs such as dyspnea and rhinitis can be seen. Reproductive failure is common in breeding herds.
- Wild pigs seldom exhibit signs of infection with PRV



- Migration of virus in nerve cell & epithelium

Pathogenesis

Primary viral multiplication in the cells of the nasopharyngeal mucosa

Virus gains entry into the central nervous system (CNS) via various cranial nerves

Virus transfer along nerve fibres takes place within the axoplasm and through Schwann's cells and fibroblasts of the endoneurium

Other pathways of viral dissemination throughout the body include the lymphatics

Further viral multiplication occurs in lymph nodes

Virus enters the vascular system carried by phagocytes

Pseudorabies virus proliferate in capillary endothelium, ganglion cells, satellite cells, Schwann's cells, lymphocytes and macrophages

Pathogenesis

- Oronasal infection, primary replication occurs in the upper respiratory tract
- Virus then invades sensory nerve endings in the face and oropharynx, including the olfactory, trigeminal, and glossopharyngeal nerves
- PRV spreads to the cell bodies of infected neurons via axonal retrograde transport
- Viremia results in dissemination to other organs
- Replication occurs in epithelium, vascular endothelium, lymphocytes, and macrophages



SuHV-1 is excreted by suids in

Nasal exudates

Saliva

vaginal mucus & Sperm

Sperm

Milk

Faeces

Sperm

occasionally urine



Route of infection

- Different routes of infection by SuHV-1 are potentially possible because there is some, unquantified, survival of the virus in the environment, particularly in organic material, and some persistence in aerosols.
- **Direct contact** –
 - animal-to-animal (nose-to-nose) with SuHV-1 excreting boar
 - ingestion of infected meat
 - inanimate objects, such as boots, clothing, feed, trucks, and equipment
- **Indirect contact** - with infected fomites or aerosols.



Mode of transmission

- Transmission by the aerosol route
 - low in hot and dry weather conditions (unfavourable for the virus)
 - enhanced if weather conditions are cool and wet.
- Natural infection - by the oro-nasal
 - ruminants are infected by the nasal route
 - carnivores by the oral route.
- Suckling pigs can acquire SuHV-1 from the milk of infected sows, or infection may already have taken place in the uterus.
- Venereal transmission - primary importance for SuHV-1 transmission pig populations

- Virus persists primarily in the
 - trigeminal ganglia (the predominant site domestic pigs)
 - sacral ganglia (the predominant site in wild pigs)
 - tonsils
- Recovered pig - potential latent carrier

Latent carrier

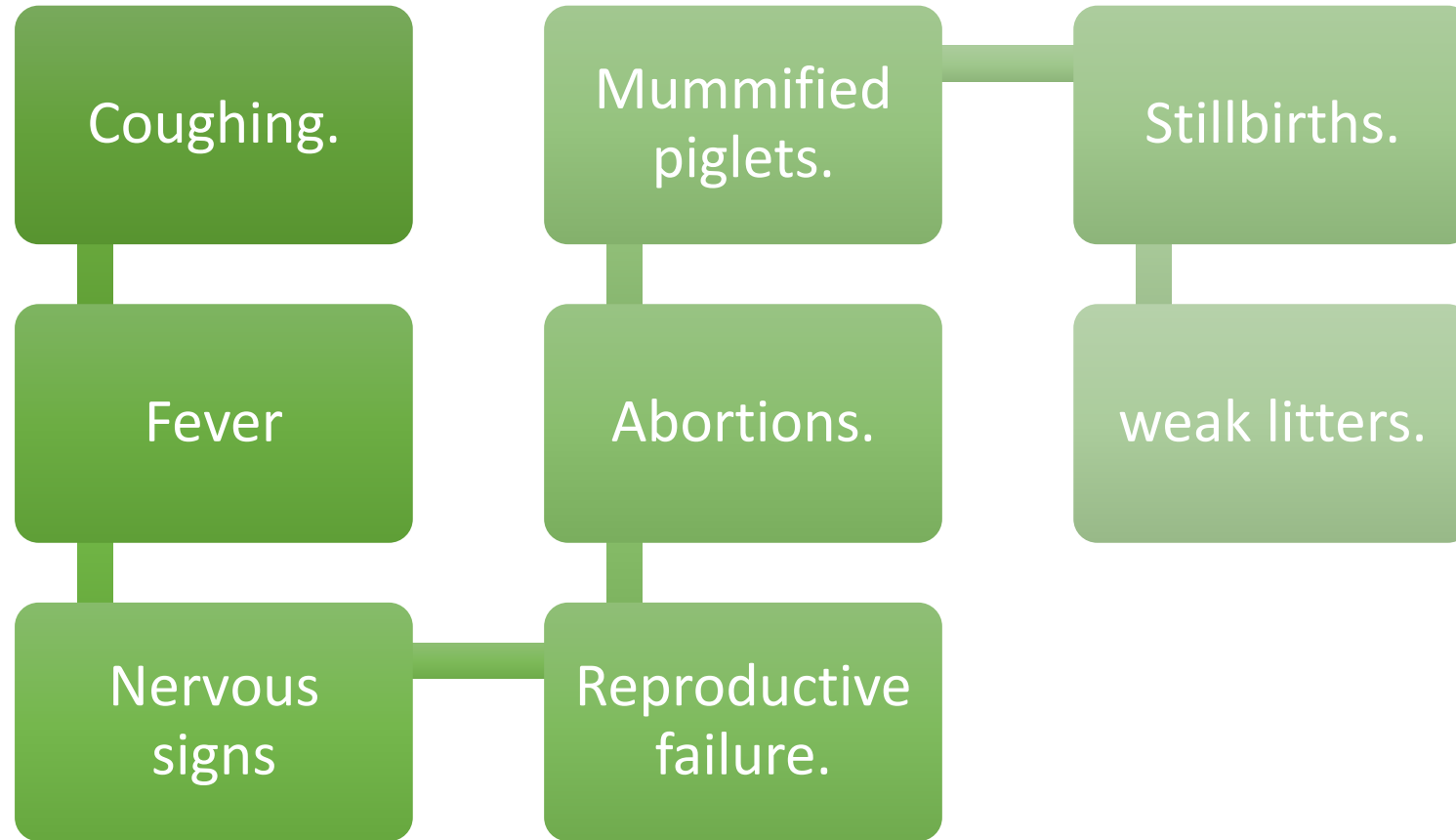
Clinical signs - Acute disease

- The virus crosses the uterus and placenta and infects the foetus.
- Abortions, stillbirths and the birth of weak litters.
- Reproductive failure at all stages of the cycle.
- Embryos are killed and absorbed and sows return to heat.
- Dogs and cattle - show nervous signs and die.

Clinical signs - Chronic disease

- Depression of reproductive efficiency
 - increased levels of repeats
 - mummification
 - stillbirths
 - piglet mortality
- Young carrier females - shed virus thus maintaining infection throughout the herd.

“Pigs that have recovered from PRV infection may become asymptomatic carriers.”



Mummified pigs, a symptom of Pseudorabies

Clinical signs – Sows

Lesions on nose of piglet

Clinical signs - Piglets

- Nervous signs.
- Incoordination.
- Sneezing.
- Coughing.
- High mortality.
- Low / poor viable piglets.



Stillbirth

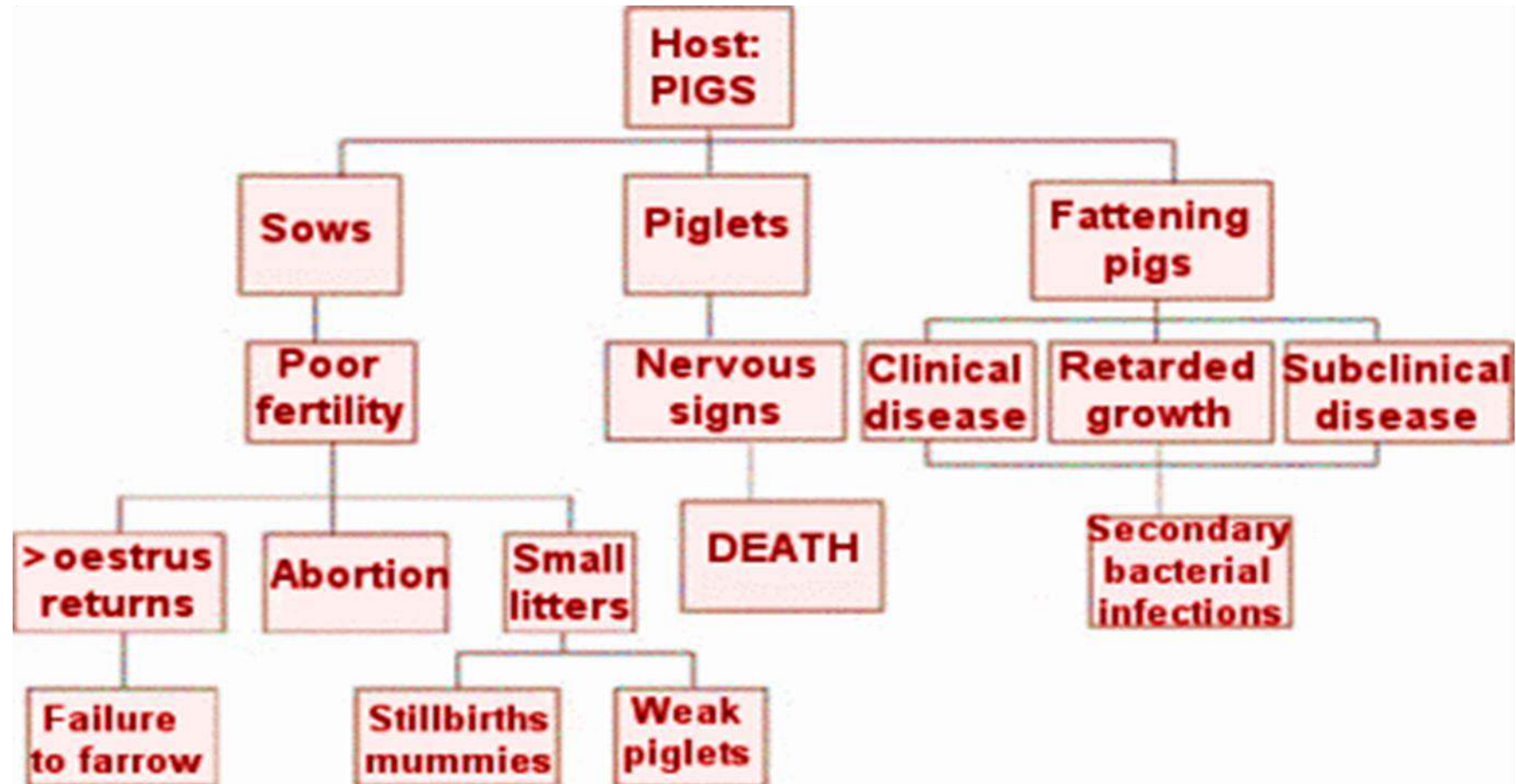
Clinical signs: Weaners & Growers

- Fever.
- Sneezing.
- Coughing.
- Pneumonia.
- Nervous signs
 - including incoordination, fits and meningitis.
- severe respiratory disease and severe rhinitis.
- Usually low mortality.



Dead pigs (and a cat), due to Pseudorabies

Clinical signs: summary





Diagnosis



■ Clinical History

When a susceptible breeding herd first breaks down with this disease the clinical signs described above strongly suggest Aujeszky's disease and are almost diagnostic.

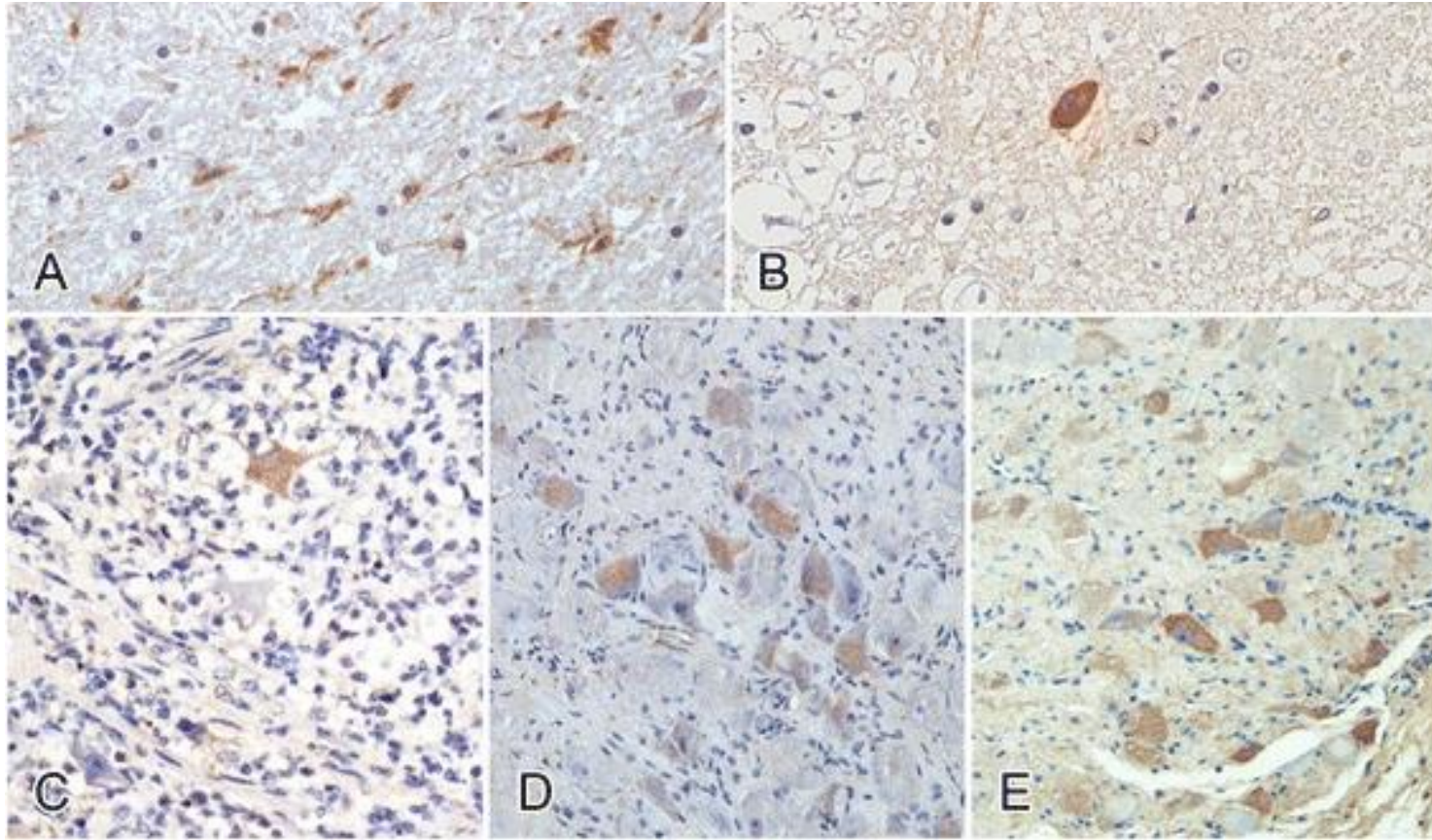
Laboratory tests are required to confirm the diagnosis. The common ones are as follows:

■ Virus isolation: from the lung and tonsils and its identification.

- ✓ virus isolation, though porcine kidney cells (PK-15, SK6) are commonly used.
- ✓ Cytopathic effect is observed within 24–72 hours

■ Virus antigen detection:

- **Immunoperoxidase or Immunofluorescence** on dead piglet tissues particularly tonsils.
- **Serology:** to demonstrate rising antibodies via anti-gE ELISA
- **PCR:** amplification with primers of conserved sequence(gB or gD genes)

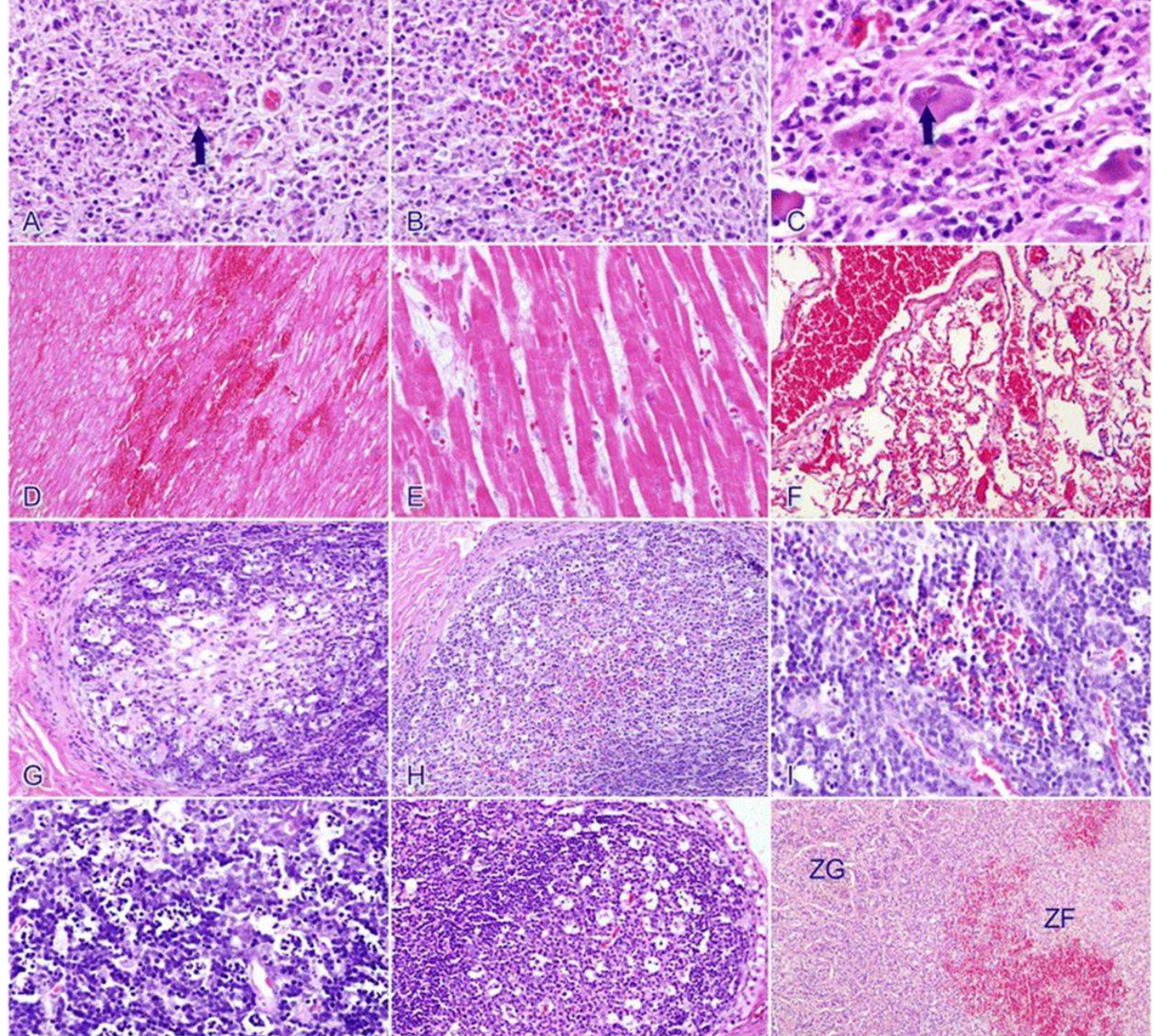


- A: Brainstem
- B: cervical spinal cord
- C: stellate ganglion
- D: celiac ganglion
- E: caudal mesenteric ganglion.

Immunohistochemical
detection of PRV antigen

Histopathology

- **A:** Stellate ganglion, salient gliosis and neuronophagia (arrow), and nuclear debris from necrotic cells are frequently observed (HE)
- **B:** stellate ganglion, showing mild hemorrhage (HE)
- **C:** stellate ganglion, acidophilic intranuclear inclusion bodies (arrow) (HE)
- **D:** cardiac muscle, extensive myocardial hemorrhage and necrosis in the myocardium, swelling and vacuolization of the muscle fibers, loss of striation, and granular fibers are visible (HE)
- **E:** cardiac muscle, less-severe changes with the accumulation of eosinophilic fiber-like exudates in the myocardial interstitium (HE);
- **F:** lung, pulmonary hemorrhage and congestion (HE);
- **G:** ileum, lymphoid depletion in the lymphatic nodules (starry sky aspect) (HE);
- **H:** cecum, mild hemorrhage in the lymphoid nodules (HE);
- **I:** thymus, mild hemorrhage (HE);
- **J:** thymus, showing lymphoid-depleted areas (HE);
- **K:** mesenteric lymph nodes, showing lymphoid depletion (HE);
- **L:** adrenal gland, hemorrhage in the zona fasciculata, ZG, zona glomerulosa; ZF, zona fasciculata (HE)



Prevention & Control

- Culling of prv-positive herds
- Vaccination programs with ‘marker’ viruses such as ge-deleted strains (**bartha-k61**, an attenuated vaccine)
- Restricted importation of swine
- Isolation of domestic swine from wild boar
- Vaccination with



“Pigs that have recovered from PRV infection may become asymptomatic carriers.”



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