Duck plague
Anatid herpesvirus 1

Virology Lecture Series

Order: *Herpesvirales*

With special emphasis on

Family: Orthoherpesviridae

and a few members of

Family: Alloherpesviridae

By

Professor I. M. Reda رحمه الله

&

Professor Ausama A. A. Yousif

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- Describe the physical properties of viruses belonging to *Orthoherpesviridae*.
- Describe the common features of *Orthoherpesviridae* members' genomes.
- List subfamilies and genera included in *Orthoherpesviridae.*
- Discuss briefly some important pathogenesis and transmission features of animal and zoonotic members of *Herpesvirales*.
- List available vaccine types for select *Orthoherpesviridae and Alloherpesviridae* members.
- List diagnostic approaches available.

Learning objectives

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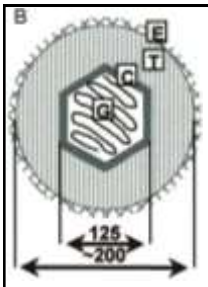
Introduction

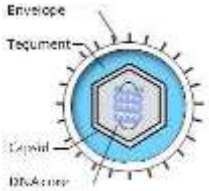
- Herpesviruses have been found in insects, reptiles, amphibians, mollusks as well every species of birds and mammals that has been investigated.
- At least one major disease of each domestic animal species is caused by a herpesvirus e.g. Infectious bovine rhinotracheitis, and Marek's Disease.
- Sheep is the exception so far (they are infected, but only subclinical, by ovine herpesvirus 2).



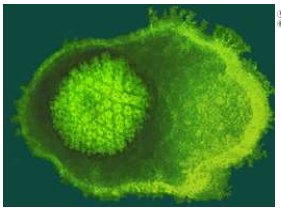
https://ictv.global/report_9th/dsDNA/Herpesvirales

Virion Properties

- Enveloped (with peplomers).
- Icosahedral nucleocapsid composed of 162 capsomers.
- Surrounding the capsid is a layer of globular material known as tegument.
- Double-stranded DNA genome wrapped around a fibrous spool-like core.

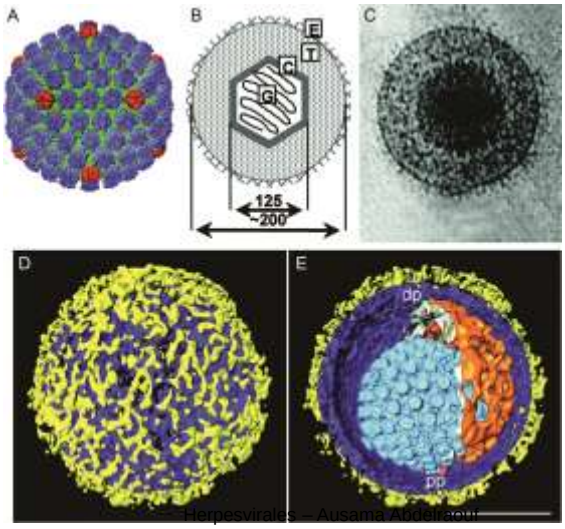


http://stdgen.northwestern.edu/stdgen/bacteria/hhv2/herpes.html



The 12th vertex is a portal to the inside of the capsid and is essential for encapsidation of the genome

https://ictv.global/report_9th/dsDNA/Herpesvirales



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https://en.wikipedia.org/wiki/Herpesvirales

Virus Taxonomy

Book: Orthoherpesviridae

- Family: Orthoherpesviridae
  - Subfamily: Alphaherpesvirinae
    - Genus: Iltovirus
    - Genus: Mardivirus
    - Genus: Scutavirus
    - Genus: Simplexvirus
    - Genus: Varicellovirus
  - Subfamily: Betaherpesvirinae
    - Genus: Cytomegalovirus
    - Genus: Muromegalovirus
    - Genus: Proboscivirus
    - Genus: Quwivirus
    - Genus: Roseolovirus
  - Subfamily: Gammaherpesvirinae
    - Genus: Bossavirus
    - Genus: Lymphocryptovirus
    - Genus: Macavirus
    - Genus: Manticavirus
    - Genus: Patagivirus
    - Genus: Percavirus
    - Genus: Rhadinovirus

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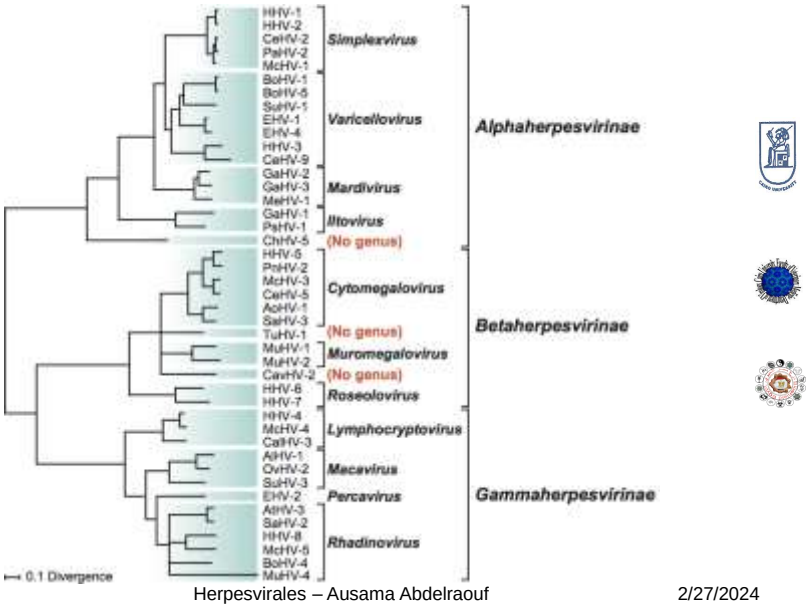
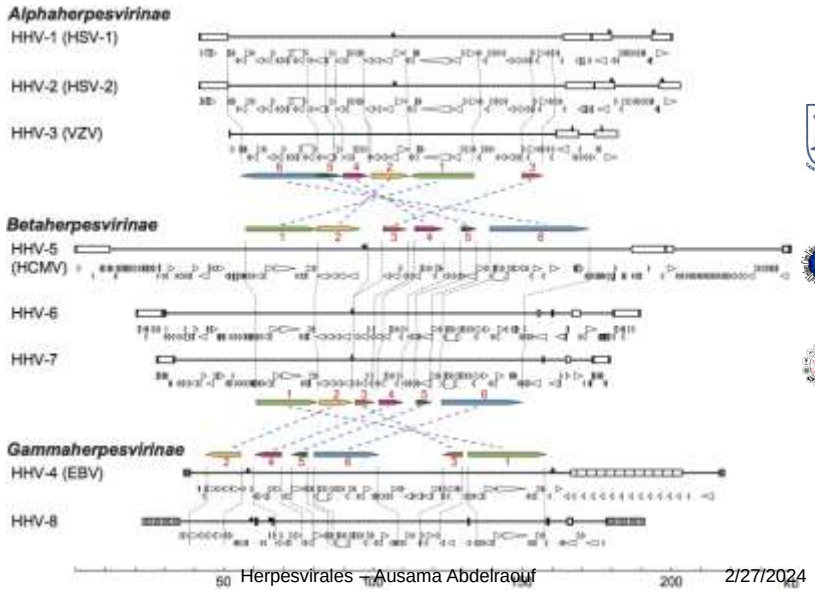
Phylogeny of select members of *Orthoherpesviridae*



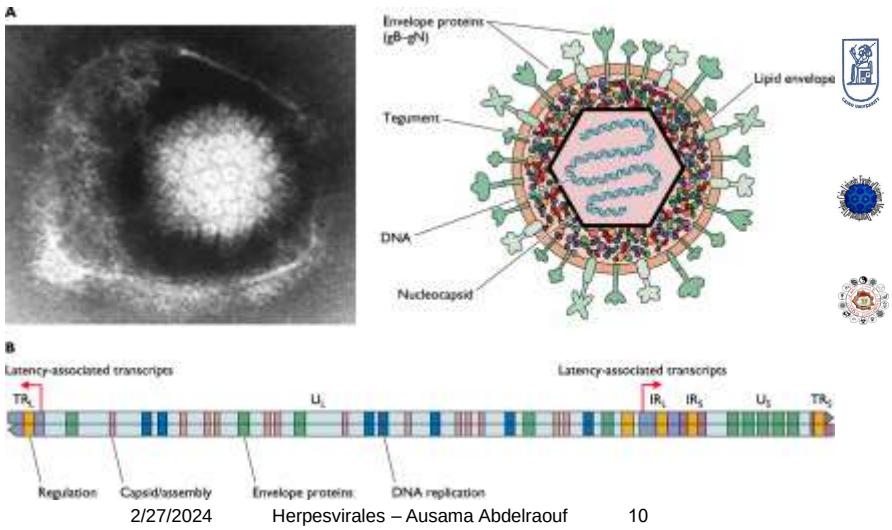
The Herpesvirus Genome

- Is a single linear molecule of double stranded DNA.
- 125-235 kbp in size.
- There is remarkable degree of variation in the composition, size and organization of the genomes of herpesviruses.

Genomes are highly complex



Different sets of genes are responsible for different functions in the virus lifecycle



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Genes of Herpesviruses

Herpes virus genes fall in 3 categories:

1-Those encoding proteins concerned with viral replication (immediate early and early genes)

2-Encoding structural proteins (late genes).

3-Heterologous set of genes, not found in all herpes viruses and not essential for replication .

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Proteins of herpesviruses

Herpesvirus virion contains:

Over 30 structural proteins, of which 6 are present in the nucleocapsid and 2 DNA associated.

About 12 glycoproteins are located in the envelope from which they project as peplomers. One of the peplomer glycoproteins has Fc receptor activity and binds normal IgG

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Viral Replication

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1-Attachment by binding of viral glycoproteins to host cell receptors (one of which is heparin sulphate proteoglycan).

2-The nucleocapsid enters the cytoplasm.

3-The DNA-protein complex is freed from nucleocapsid and enters the nucleus→ quickly shutting off host cell macromolecular synthesis.

There are 3 classes of mRNA: alpha, Beta and gamma.

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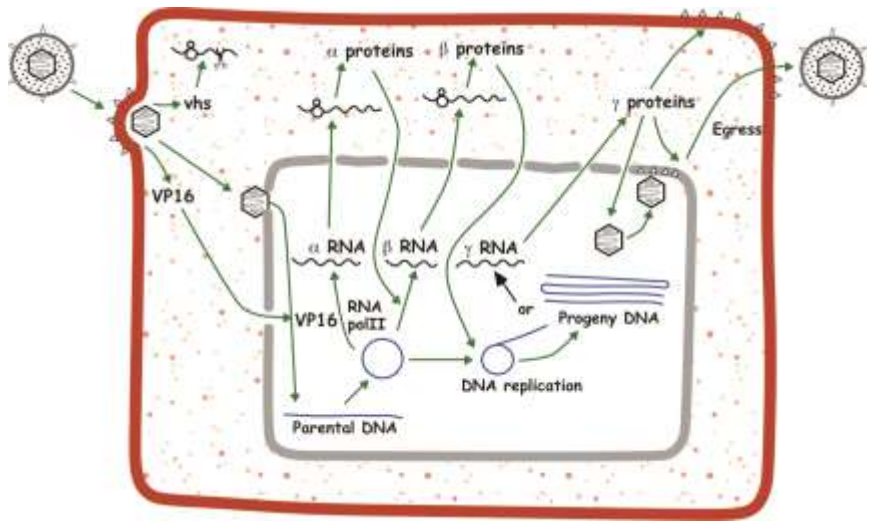

Virus multiplication cycle

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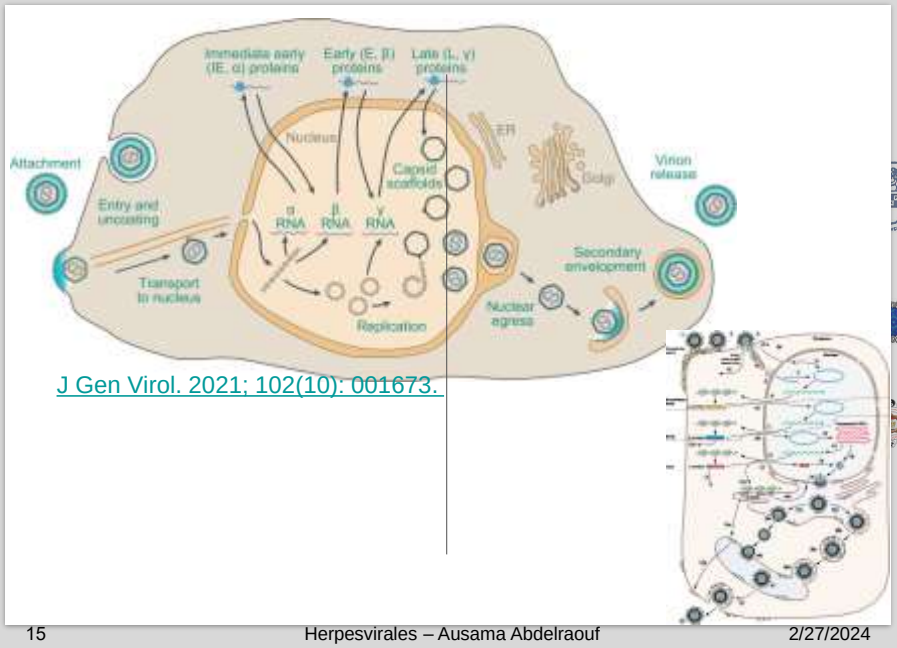


J Gen Virol. 2021; 102(10): 001673.

Replication: Cont.

- DNA is spooled into preformed capsids.
- Association of nucleocapsids with altered inner layer of nuclear envelope.
- Budding from inner nuclear membrane.
- Mature virions accumulate within vacuoles in the cytoplasm.
- Release by exocytosis or cytolysis.

Inclusion bodies

- Intranuclear inclusion bodies are characteristic of herpesvirus infections and can usually be found both in appropriately fixed and stained tissues from herpesvirus-infected animals and in cell cultures.

Transmission and pathogenesis (Select models)

- Transmission is generally associated with mucosal contact; droplet infection is also common.
- In pregnant animals, a mononuclear cell associated viremia may result in the transfer of virus across the placenta leading to abortion with focal necrotic lesions found throughout the fetus.

Persistent infections

- Marek's disease virus causes a polyclonal T lymphocyte tumor due to oncogenic genes carried by the virus.
- Persistent infection with periodic or continuous shedding occurs in all herpesvirus infections.
- In alphaherpesviruses infections, multiple copies of viral DNA are demonstrable either as episomes or more rarely integrated in chromosomal DNA of latently infected neurons.

Pathogenesis: Cont.


Inherited chromosomally integrated human herpesvirus 6 as a predisposing risk factor for the development of angina pectoris


Short report | Open access | Published: 21 September 2010

Integration of bovine herpesvirus 4 genome into cultured persistently infected host cell genome

Pathogenesis: Cont.

- The latent genome is essentially silent except for the production of a latency-associated transcript, whose function in the establishment, maintenance and reactivation of latent infection is not known.
- Reactivation is usually associated with stress due to inter-current infections, shipping cold or crowding.

Pathogenesis: Cont.

- Shedding of virus from nasal, oral or genital secretions provides a source of infection to other animals and from dam to offspring.
- MDV is shed from feathers of infected chickens and is transmitted via the respiratory tract of chickens through inhalation of contaminated dust or feather follicle dander.
- Some Betaherpesviruses and Gammaherpesviruses are shed continuously from epithelial surfaces.

Diagnosis and Control

- Diagnosis (check your laboratory manual and tell me.).
- Control (inactivated and live virus vaccines)
- When do you think we should vaccinate with live vaccines? (Not during……)

Now, let us take a look at select members of the order.

Iltovirus gallidalpha1

formerly

Gallid alphaherpesvirus 1

Infectious Laryngeotracheitis (ILT)

Control

- Hygiene and bio-security.
- Vaccines:
  - TC origin (highly attenuated).
  - CE origin (hotter may revert).
- Vaccinate all birds in an outbreak.

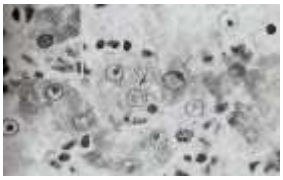
Psittacid herpesvirus 1 and infectious laryngotracheitis virus: Comparative genome sequence analysis of two avian alphaherpesviruses

Dean K Thureen [?], Calvin L Keeler Jr

Affiliations + expand
PMID: 16872243 PMCID: PMC1563825 DOI: 10.1128/JVI.00134-06
Free PMC article

Abstract

Psittacid herpesvirus 1 (PsHV-1) is the causative agent of Pacheco's disease, an acute, highly contagious, and potentially lethal respiratory herpesvirus infection in psittacine birds, while infectious laryngotracheitis virus (ILTV) is a highly contagious and economically significant avian herpesvirus which is responsible for an acute respiratory disease limited to galliform birds. The complete genome sequence of PsHV-1 has been determined and compared to the ILTV sequence, assembled from published data. The PsHV-1 and ILTV genomes exhibit similar structural characteristics and are 163,025 bp and 148,665 bp in length, respectively. The PsHV-1 genome contains 73 predicted open reading frames (ORFs), while the ILTV genome contains 77 predicted ORFs. Both genomes contain an



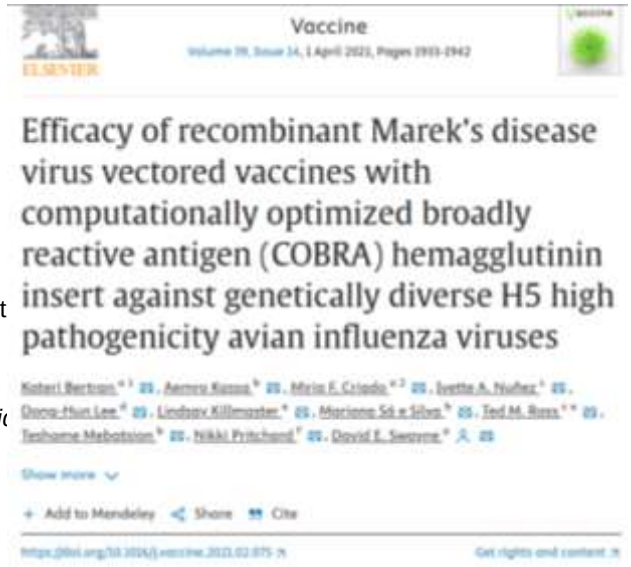
https://www.genimal.com/dna-tests/bird/pacheco-disease-bird/

Mardivirus gallidalpha2

Marek's Disease Virus (MDV)

VACCINES for MDV

- Turkey herpesvirus (HVT, naturally avirulent *Meleagrid alphaherpesvirus* 1)
- SB-1 or 301B/1 (naturally avirulent *Galli alphaherpesvirus 3*)
- CVI988/Rispens (attenuated *Gallid alphaherpesvirus 2*).
- Also, recombinant.

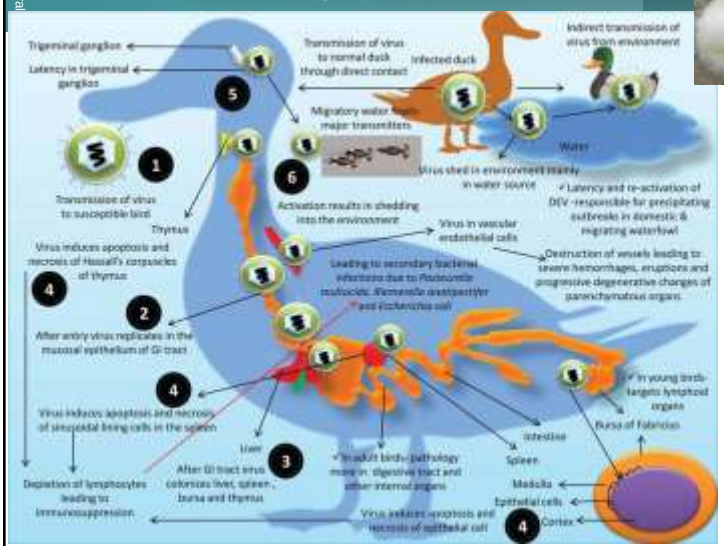

Vaccine

Efficacy of recombinant Marek's disease virus vectored vaccines with computationally optimized broadly reactive antigen (COBRA) hemagglutinin insert against genetically diverse H5 high pathogenicity avian influenza viruses

Herpesviral

Duck plague / duck viral enteritis
Anatid alphaherpesvirus 1 (AnHV-1)
Mardivirus anatidalpha1

https://hanovetvn.com/san-pham/benh-dich-ta-vit-duck-virus-enteritis-duck-plague-pestis-anatum/



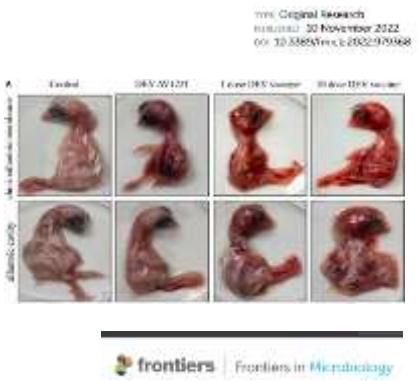
Duck virus enteritis (duck plague) - a comprehensive update. The Veterinary quarterly. 37. 57-80. 10.1080/01652176.2017.1298885.

Herpesvirales

Duck plague / duck viral enteritis
Anatid alphaherpesvirus 1 (AnHV-1)
Mardivirus anatidalpha1

Vaccines

Pathogenicity and transmissibility studies on live attenuated duck enteritis virus vaccine in non-target species



frontiers | Frontiers in Microbiology

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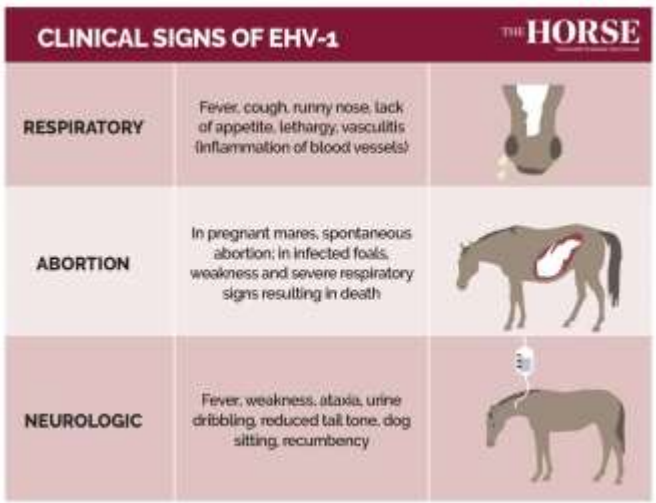
Equine Herpesvirus 1



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Equine Herpesvirus 1

Journal of Equine Veterinary Science
Volume 87, April 2020, 102923

Review Article

Equine Herpesvirus-I Infection in Horses: Recent Updates on its Pathogenicity, Vaccination, and Preventive Management Strategies

Ameer Khusro [a], Chirom Aarti [a], Raymundo Rene Rivas-Caceres [b], Alberto Barbabosa-Pliego [c]

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https://doi.org/10.1016/j.jevs.2020.102923 Get rights and content

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Equid alphaherpesvirus 3

Equine Coital Exanthema: New Insights on the Knowledge and Leading Perspectives for Treatment and Prevention

Pathogens **2021**, *10*(8), 1055; https://doi.org/10.3390/pathogens10081055

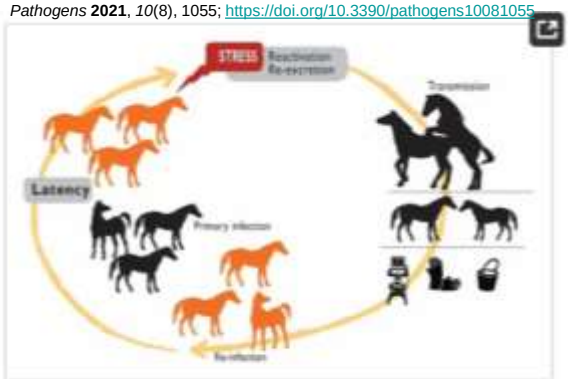

Figure 1. Transmission cycle of *equid alphaherpesvirus 3* (EHV-3) in mares and stallions.

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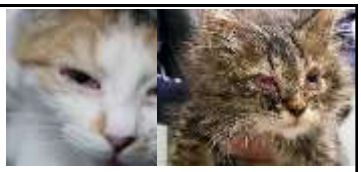
Vaccines

- Foals: Administer a primary series of 3 doses of **inactivated EHV-1/EHV-4 vaccine or modified-live EHV-1 vaccine**, beginning at 4 to 6 months of age and with a 4-to-6-week interval between the first and second doses.
- Yearly for older animals.
- You may still get the nervous signs especially for EHV-1.

Herpesvirus Infection in Cats (Feline Viral Rhinotracheitis and feline herpes dermatitis)



ISRN Vet Sci. 2012; 2012: 495830
Published online 2012 Nov 14. doi: 10.5402/2012/495830

Felid Herpesvirus Type 1 Infection in Cats: A Natural Host Model for Alphaherpesvirus Pathogenesis

Roger Maes*

• Author information • Article notes • Copyright and License information PMC Disclaimer

Abstract

Feline herpesvirus 1 (FeHV-1) is an alphaherpesvirus that causes feline viral rhinotracheitis, an important viral disease of cats on a worldwide basis. Acute FeHV-1 infection is associated with both upper respiratory and ocular signs. Following the acute phase of the disease lifelong latency is established, primarily in sensory neuronal cells. As is the case with human herpes simplex viruses, latency reactivation can result in recrudescence, which can manifest itself in the form of serious ocular lesions. FeHV-1 infection in cats is a natural host model that is useful for the identification of viral virulence genes that play a role in replication at the mucosal portals of entry or are mediators of the establishment, maintenance, or reactivation of latency. It is also a model system for defining innate and adaptive immunity mechanisms and for immunization strategies that can lead to better protection against this and other alphaherpesvirus infections.

Canine herpesvirus 1 (CaHV-1) is **a *Varicellovirus* of the *Orthoherpesviridae*** (also called Varicellovirus Canidalpha1 according to the latest revision of ICTV)

https://www.vdl.ndsu.edu/mystery-photo-march-2023/

HHV1 in Marmoset
https://doi.org/10.1111/j.1469-0691.2010.03163.x

Macacine herpesvirus 1

B-Virus (Cercopithecine herpesvirus 1) Infection in Humans and Macaques: Potential for Zoonotic Disease

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Vaccines IBR BHV-1

- **Inactivated and modified live BHV-1 vaccines are available**. As with all herpesvirus vaccines they can reduce clinical signs and reduce viral shedding but cannot completely prevent infection.
- Live vaccines are not recommended for pregnant animals.

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Sheep-associated malignant catarrhal fever (SA-MCF) OHV-2 and MCF

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Family Alloherpesviridae

Detection of cyprinid herpesvirus 1 (CyHV-1) in barbel (*Barbus barbus*): First molecular evidence for the presence of CyHV-1 in fish other than carp (*Cyprinus carpio*)

Abstract

Safe management of Cyprinid herpesvirus 3-induced mortalities of common carp (*Cyprinus carpio*) by silaging process

https://doi.org/10.1016/j.aqrep.2022.101116

Diagnosis

- Presumptive diagnosis (see clinical signs and PM) (see your lab manual).
- Isolation on (see your lab manual).
- Identification (see your lab manual).

Acknowledgements

- I.M. Reda. Professor of Virology, Cairo University.