



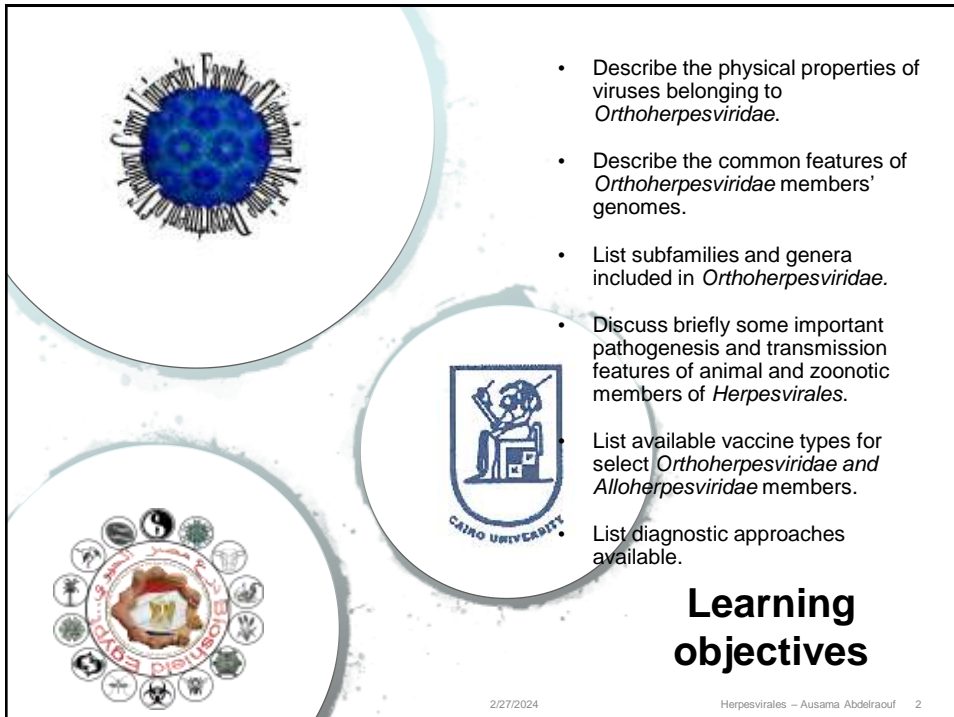
Duck plague
Anatid herpesvirus 1

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

- 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

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).



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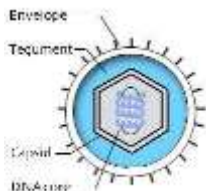
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https://ictv.global/report_9th/dsDNA/Herpesvirales

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.

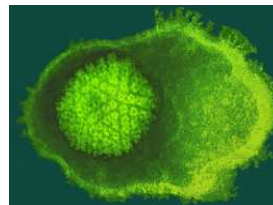


<http://stdgen.northwestern.edu/stdgen/bacteria/hhv2/herpes.html>

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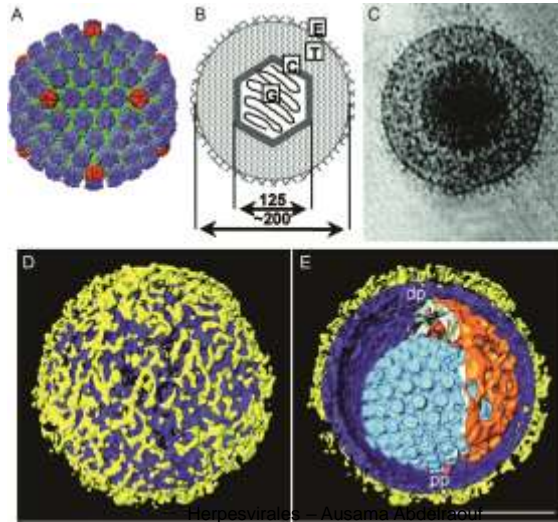
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The 12th vertex is a portal to the inside of the capsid and is essential for encapsidation of the genome

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



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Virus Taxonomy

The ICTV Department
Virus Classification and Nomenclature

Book: Orthoherpesviridae

Family: Orthoherpesviridae

Subfamily: Alphaherpesvirinae

- Genus: *H1ovirus*
- Genus: *Mardivirus*
- Genus: *Scutavirus*
- Genus: *Simplexvirus*
- Genus: *Varicellovirus*

Subfamily: Betaherpesvirinae

- Genus: *Cytomegalovirus*
- Genus: *Murineglovirus*
- Genus: *Proboscivirus*
- Genus: *Quinnvirus*
- Genus: *Rosolovirus*

Subfamily: Gammaherpesvirinae

- Genus: *Bossovirus*
- Genus: *Lymphocryptovirus*
- Genus: *Macrovirus*
- Genus: *Mantecavirus*
- Genus: *Pittagovirus*
- Genus: *Percovirus*
- Genus: *Rhadinovirus*

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

Virus classification

Domain: Virus
 Realm: Duplodornata
 Kingdom: Mesospirillum
 Phylum: Papillavirata
 Class: Herpesvirales
 Order: Herpesvirales

Families

- Alphaherpesviridae
- Betaherpesviridae
- Gammaherpesviridae



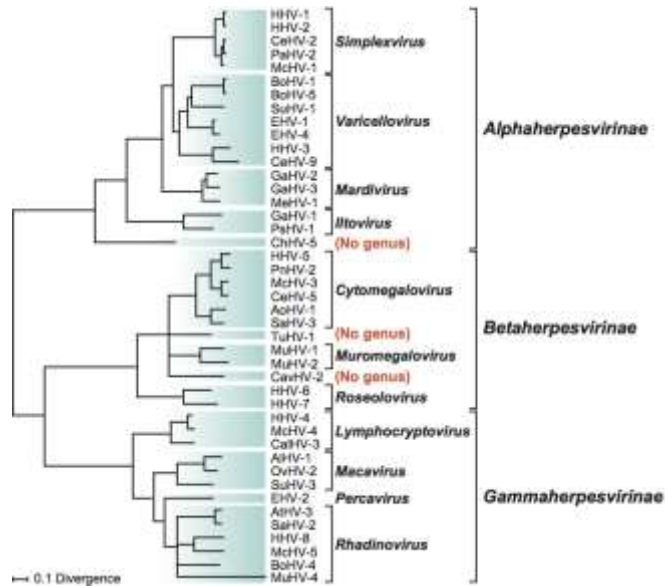
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Phylogeny of select members of *Orthoherpesviridae*



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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.

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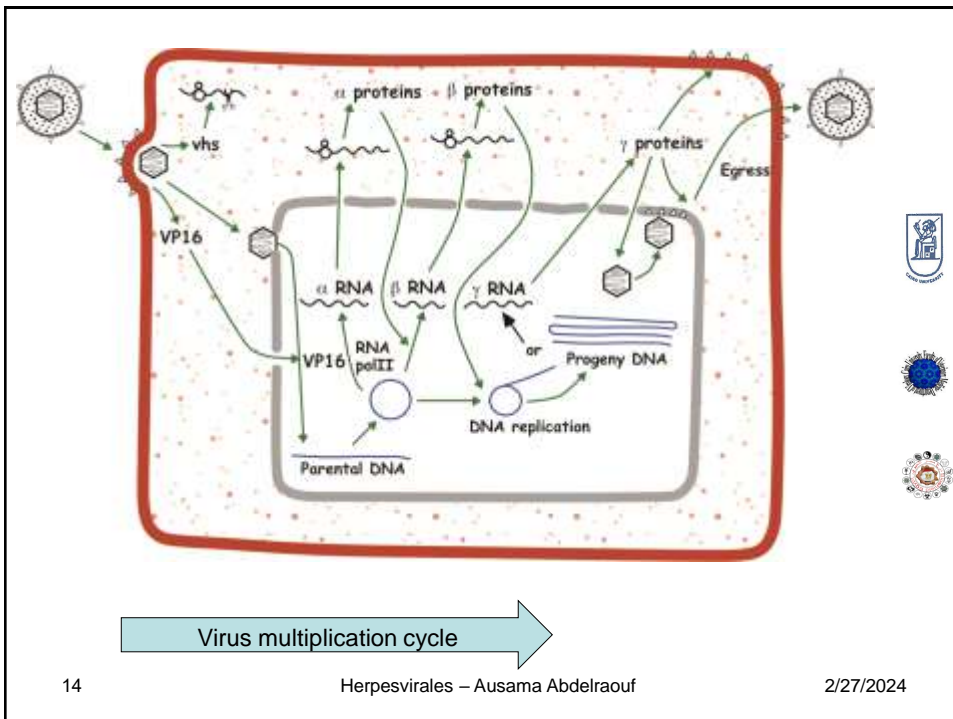
1-Attachment by binding of viral glycoproteins to host cell receptors (one of which is heparin sulphate proteoglycan).

2-The nucleocapsid enters the cytoplasm.

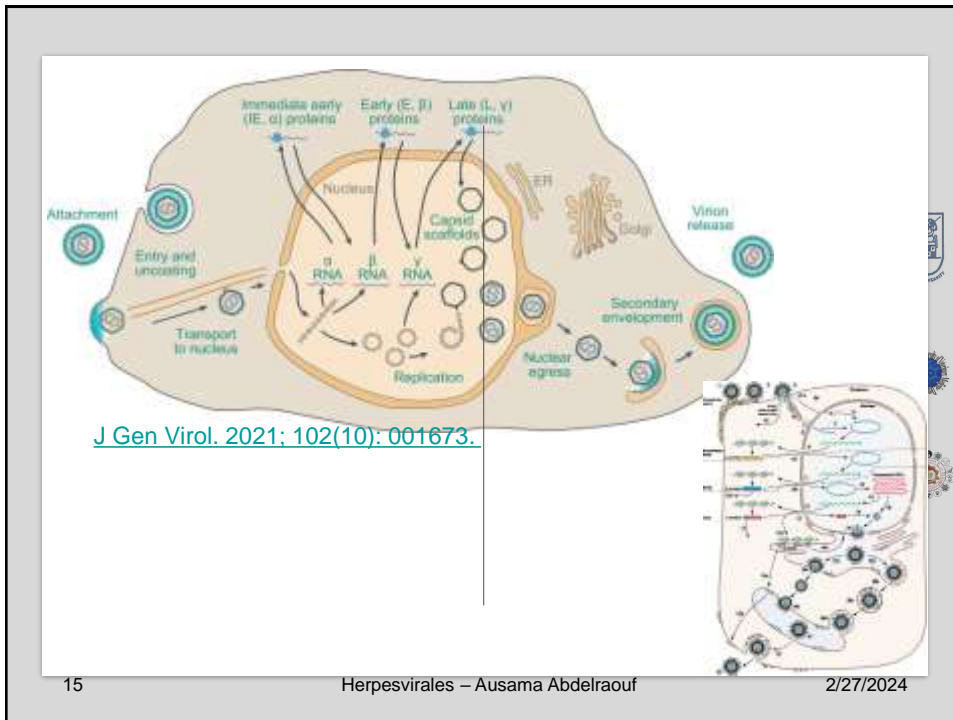
3-The DNA-protein complex is freed from nucleocapsid and enters the nucleus → quickly shutting off host cell macromolecular synthesis.

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

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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.



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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.

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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.



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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

Armin Gassner, Isabelle Dubois, Guillaume Morellet,  and Lucie Goulet  [Authors' info & affiliations](#)

Submitted by Armin G. Gassner, Institute of Virology, University of Western Ontario, London, Ontario, N6A 3K7, Canada (AG) and approved by AG, 15. 2010
Approved for online February 2, 2010

June 16, 2010 | [112 \(2010\) 246](#) | <https://doi.org/10.1016/j.virol.2010.06.011>

Short report | [Open access](#) | Published: 21 September 2010

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

Giuseppe Donofrio , Armin Gassner, Valeria Franzoni, Lisa De Lazzari, Vicky van Santen & Ettore Palma

Virology Journal, 7, Article number 246 (2010) | [View this article](#)

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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.



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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.

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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.....)



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

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Iltovirus gallidalpha 1
formerly
Gallid alphaherpesvirus 1
Infectious
Laryngeotracheitis
(ILT)








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Control

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



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

Dean K. Runyon¹, Cahin I. Koster²

Affiliations: [1](#) [2](#) expand

PMID: 36873433 PMID: 340356825 DOI: 10.1128/9781131406

[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 (ILT) 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 148,660 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/>

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Mardivirus gallidalpha2
Marek's Disease Virus (MDV)



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VACCINES for MDV

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

Vaccine
Volume 39, Issue 11, 1 April 2023, Pages 2903–2942

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

Kateri Bertoni^{1,2}, Aemey Ramesh³, Mirza F. Czielo^{1,2}, Ivetta A. Nulhez⁴, Choo-Hyun Lee⁵, Lindsay Killmaster⁶, Miroslava Škvrta⁷, Ted M. Ross⁸, Terhoma Mabotsoa⁹, Nikki Pritchard¹⁰, David E. Swayne^{1,2}

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

Herpesviral

Transmission of virus to normal duck through direct contact

Indirect transmission of virus from environment

Migratory water - major transmitter

Water

Virus shed is environment friendly in water source

Activation results in shedding into the environment

Virus in vascular endothelial cells

Latency and re-activation of DVE responsible for precipitating outbreaks in domestic & migrating waterfowl

Destruction of vessels leading to severe hemorrhages, eruptions and progressive degenerative changes of pancreatic organs

Leading to secondary bacterial infections due to *Pasteurella multocida*, *Aeromonas hydrophila* and *Escherichia coli*

In young birds - targets lymphoid organs

Bursa of Fabricius

In adult birds - pathology more in digestive tract and other internal organs

Spleen

Intestine

Medulla

Epithelial cells

Cortex

Virus induces apoptosis and necrosis of reticular cells

Virus induces apoptosis and necrosis of sinusoidal lining cells in the spleen

After GI tract virus colonizes liver, spleen, bursa and thymus

Depletion of lymphocytes leading to immunosuppression

Virus induces apoptosis and necrosis of Hassall's corpuscles of thymus

After entry virus replicates in the mucosal epithelium of GI tract

Transmission of virus to susceptible birds

Thymus

Trigeminal ganglion

Latency in trigeminal ganglion

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<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.

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

Vaccines

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

In the second half of 2021, a highly pathogenic case occurred in a mixed chicken and duck family farm in Guangdong, China. After the duck flocks were immunized with live attenuated duck enteritis virus vaccine (live attenuated DEV vaccine), the chickens of the same farm showed clinical symptoms similar to duck enteritis, such as pericardial effusion, hepatic hemorrhagic spots, kidney enlargement, and intestinal bleeding, with mass mortality. The infection model of target animal tested, as well as the non-target species, was established according to the risk of live attenuated DEV vaccine and transmission in chickens. Live attenuated DEV vaccine was initially replicated in host animals, released the virus, and effectively colonized in the common environment, according to birds challenged experiments. There was evidence to suggest the mode of transmission of duck enteritis virus, and horizontal transmission is the main route of DEV transmission. In addition, high levels of virus titer were detected in chicken embryos and different tissues of SPF chickens. Different degrees of pathological damage occurred in the tissue of chickens. After the SPF chickens were inoculated with live attenuated DEV vaccine, different degrees of virulence were exhibited, pointing to a potential risk to other domestic bird species.



TYPE Original Research
PUBLISHED 20 November 2022
DOI: 10.3389/fvets.2022.959688

frontiers | Frontiers in Veterinary Science

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Equine Herpesvirus 1

CLINICAL SIGNS OF EHV-1		THE HORSE
RESPIRATORY	Fever, cough, runny nose, lack of appetite, lethargy, vasculitis (inflammation of blood vessels)	
ABORTION	In pregnant mares, spontaneous abortion; in infected foals, weakness and severe respiratory signs resulting in death	
NEUROLOGIC	Fever, weakness, ataxia, urine dribbling, reduced tail tone, dog sitting, recumbency	



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Equine Herpesvirus 1



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



Review Article

Equine Herpesvirus-1 Infection in Horses: Recent Updates on its Pathogenicity, Vaccination, and Preventive Management Strategies

Ameer Khuroo^a, Chitrom Aarti^b, Raymundo Rene Rivas-Caceres^b,
Alberto Barbabosa-Pliego^c

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<https://doi.org/10.1016/j.jevs.2020.102923>

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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)



[PLOS ONE](#) | Vol 7(3) | 2012 | 2012: 495830

Published online 2012 Nov 14. doi: [10.1371/journal.pone.0195830](https://doi.org/10.1371/journal.pone.0195830)

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

Roger Maes¹

[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/>

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Macacine herpesvirus 1

HHV1 in Marmoset
<https://doi.org/10.1111/j.1469-0691.2010.03161.x>

Journal of Internal Medicine 2010; 268: 248–256

B-Virus (Cercopithecine herpesvirus 1) infection in humans and macaques: Potential for zoonotic disease

Jacobson L, et al. *J Intern Med* 2010; 268: 248–256

Autism spectrum – Etiology and associated conditions – *Dev Disabil Res*

Abstract

Nonhuman primates are widely used in biomedical research because of their genetic, anatomic, and physiologic similarities to humans. In this setting, humans contact directly with macaques or with their tissues and fluids, necessitating concern. Cercopithecine herpesvirus 1 (CHV-1), an alpha-herpesvirus endemic to Asian macaques, is closely related to herpes simplex virus (HSV). Most macaques carry CHV-1 virus without overt signs of disease. However, macaque infection with CHV-1 virus usually results in fatal encephalomyelitis or severe neurologic impairment. Although the incidence of human infection with CHV-1 virus is low, a death rate of >70% before the availability of antiviral therapy makes this virus a serious zoonotic threat. Knowledge of the clinical signs and risk factors for human CHV-1 disease allows early initiation of antiviral therapy and prevents severe disease or death.



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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.

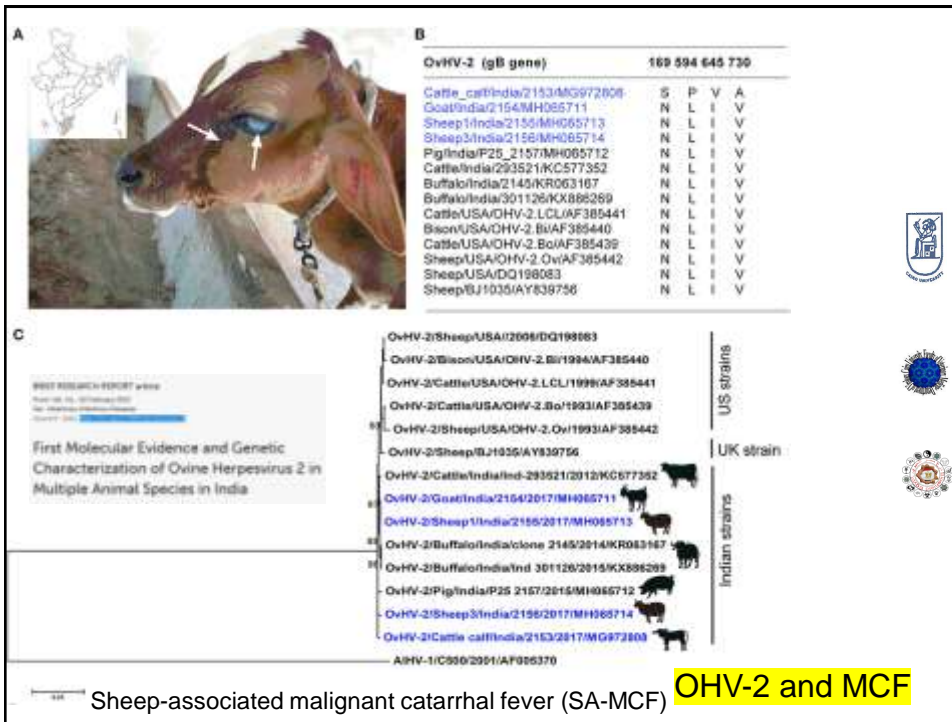


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Family Alloherpesviridae

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*)

Author: Amina Samir, Engyany Ibrahim, Fatma Sadek, Doha Soliman, et al.

Pages: 1-10 | Article Category: Research Article | DOI: 10.1016/j.aqrep.2022.101116

Abstract

Two adult barbels (*Barbus barbus*) with visible skin lesions were subjected to histopathological and molecular examinations. The fish were caught in the River Barbeba near Bahariya, Fayoum. Papillomas were found around their oral cavity at the operculum and at the pericardial fins, while vesicular hemorrhages were seen on the body surface. Cyprinid herpesvirus 1 (CyHV-1) was detected in the kidney of the specimens by polymerase chain reaction (PCR), and barbel

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.

