

In: **A Concise Review of Veterinary Virology**, Carter G.R., Wise D.J. and Flores E.F. (Eds.).
International Veterinary Information Service, Ithaca NY (www.ivis.org), Last updated: 14-Dec-2005;
A3428.1205

Families with Viruses of Minor Veterinary Significance

G.R. Carter¹, **D.J. Wise**² and **E. F. Flores**³

¹Professor Emeritus of the Department of Medical Sciences and Pathobiology, Virginia-Maryland College of Veterinary Medicine, Virginia Tech, Blacksburg, Virginia, USA. ²Department of Biology, Concord University, Athens, West Virginia, USA. ³Department of Veterinary Preventive Medicine, Federal University of Santa Maria, Santa Maria, RS Brazil.

Table of Contents

Polyomaviridae
Hepadnaviridae
Filoviridae
Arenaviridae
Astroviridae
Glossary

Polyomaviridae

Viruses of this family were once included in the family Papovaviridae together with the papillomaviruses. Currently, polyomaviruses and papillomaviruses comprise two distinct families. The family is composed of circular, double stranded DNA viruses with one genus, Polyomavirus. Only one polyomavirus is a significant veterinary pathogen; however, the simian virus 40 (SV 40), the vacuolating agent, is of considerable research interest.

Viral Characteristics

- This is a family of circular double-stranded, nonenveloped, DNA viruses; virions are ~40 nm in diameter; in contrast papillomaviruses are ~55 nm in diameter.
- Replication takes place in the cell nucleus.
- Unlike papillomaviruses, polyomaviruses can readily be cultured in vitro; they often cause malignant transformation in cells from heterologous species.
- Most species cause silent infections in their natural hosts, which are frequently long lasting.

Significance

The following two polyomaviruses are of veterinary and general interest:

Budgrigar fledgling polyomavirus causes an acute, frequently fatal, generalized infection in young budgrigars.

SV40 (Simian virus 40) was isolated as a contaminant from stocks of the Sabin poliovirus vaccine and also from cultured monkey kidney cells. It induces cytopathic effects and vacuole formation in monkey cells and is oncogenic for mice and hamsters, but apparently not for humans or monkeys. The major interest in this virus and other polyomaviruses was the discovery that they were capable of producing tumors in hamsters (small DNA tumor viruses).

It is of interest that many lots of polio vaccine used in the 1950 's were contaminated with this virus. There was concern that SV40 could cause tumors in humans. Although extensive studies failed to demonstrate an association between SV40 and human tumors, recent studies have demonstrated the presence of SV40 antigen sequences in certain rare human tumors, thus renewing interest in this virus.

Hepadnaviridae

This is a family of small double-stranded DNA viruses with an icosahedral capsid covered by an envelope. They infect herons, ducks, woodchucks, squirrels and humans (the important hepatitis B virus), but are of little veterinary significance.

Viral Characteristics

- These double-shelled viruses have an icosahedral capsid covered by an envelope (40 - 48 nm in diameter).

- They have a circular DNA genome, which is partially double-stranded (~ three-fourths) and partially single-stranded (~ one-fourth).
- They require a viral encoded reverse transcriptase to replicate in that the virion DNA is synthesized from an intermediate RNA template.
- The DNA may be integrated into the host DNA of the cell during replication.
- These viruses are highly host specific, have a predilection for the liver and produce persistent infections.

Viruses of the Hepadnaviridae are placed in genera based on differences in genomic structure and on whether they are mammalian viruses (Orthohepadnavirus) or avian viruses (Avihepadnavirus).

Significance

Orthohepadnaviruses infect woodchucks and ground squirrels and one species, hepatitis B virus, causes the important human disease, hepatitis B (HB), which is often referred to as serum hepatitis.

Animal hepadnaviruses include viruses of captive woodchucks, ground squirrels and ducks. In recent years, other hepadnaviruses have been recovered from wild and domestic species such as herons, geese, marsupials and orangutans. The avian viruses can be propagated in fetal duck liver hepatocytes.

One species, duck hepatitis B virus, causes a worldwide natural infection of *Anas* species but not of Muscovy ducks. The infection is acquired congenitally and produces a chronic viremia. It does not appear to be economically significant and shouldn't be confused with the duck hepatitis caused by types of Picornavirus (Chapter 22).

It is of interest that duck hepatitis B virus is being used as an experimental model for studies of hepadnavirus infection and replication.

HBV is among the most important human pathogens and is thought to infect chronically over 300 million people worldwide. Acute or chronic hepatitis, asymptomatic persistent infection, cirrhosis and hepatocellular carcinomas are among the consequences of HBV infection.

Filoviridae

This family of enveloped, negative-sense single-stranded RNA viruses consists of what are termed Marburg-like viruses and Ebola-like viruses. These viruses, which occur in Africa, cause hemorrhagic fevers with high fatality rates in humans and some primates.

Viral Characteristics

- They are enveloped viruses with a helical nucleocapsid and linear single-stranded, negative sense DNA.
- They are morphologically distinctive in being pleomorphic and having filaments as long as 1400 nm; capsids are as long as 800 nm.
- The method of replication is similar to the Rhabdoviridae and Paramyxoviridae.
- There is a lipid envelope with peplomers (10 nm long).
- Virions contain seven structural proteins.

Significance

Filoviruses were first recovered from cases of hemorrhagic fever in German laboratory workers in the late 1960's. The Marburg virus involved was traced back to African green monkeys imported from Uganda.

Approximately one decade later, Ebola virus was recognized as the agent of hemorrhagic fever in outbreaks in Zaire and Sudan.

Eventually a similar virus was brought into the USA by macaque monkeys imported from the Philippines. Since then, sporadic outbreaks of the Ebola virus-associated disease have been reported in several African countries. In these outbreaks, introduction of the virus to human population seems to have been via an infected non-human wild host. Ebola virus is among the most lethal viruses for humans and is classified as a biosafety level 4 agent.

Although Ebola and other filoviruses are clearly zoonotic, the natural reservoirs for these viruses remain unknown and thus constitute a major challenge for epidemiologists.

Arenaviridae

Viruses of this family have a nucleocapsid and a single-stranded, circular RNA in two segments. None of these viruses is pathogenic for domestic animals but some cause significant human diseases. Their natural hosts are wild rodents.

Viral Characteristics

- These viruses are enveloped and have a helical nucleocapsid (50 - 300 nm in diameter) and a single stranded circular, negative-polarity RNA in two segments. A portion of both segments has positive-polarity RNA (although it is not translated) and thus the term ambisense is applied to this unusual genome.
- Another distinctive feature is the presence of granules (nonfunctional ribosomes) on the viral surface.
- They replicate in the cytoplasm and mature by budding through the cell membrane.

Significance

The Arenaviridae consists of two genera, Arenavirus and Deltavirus, which are discussed below with significant viruses:

Arenavirus

In rodents, most arenaviruses cause subclinical, lifelong persistent infections with continuous excretion of virus in saliva, urine and feces thus facilitating spread. Human exposure is usually occupational and more frequently involves farm workers in rural areas. Human infection may range from inapparent, mild disease to the severe and frequently lethal hemorrhagic fevers. More than 20 species of arenavirus species have been identified worldwide. All have rodents as reservoirs and some cause human disease.

The prototype of this family is the lymphocytic choriomeningitis virus (LCMV), a virus found to infect wild rodents, mice and occasionally humans. Immunological studies employing LCMV have contributed significantly to our knowledge of tolerance, virus-induced immunopathology, viral antigen recognition by T lymphocytes, natural killer activation and function, among others. Lymphocytic choriomeningitis virus is a rare cause of aseptic meningitis in humans.

Arenaviruses causing human disease must be handled in laboratories under strict containment conditions (Biosafety level 4) to prevent human exposure.

Lassa fever virus causes a frequently fatal hemorrhagic fever in humans in West Africa. The natural host is the field rat.

Deltavirus

Hepatitis delta virus (the only species) infection; complicates hepatitis B infection. It is of interest that hepatitis delta virus is distinct from all other viruses in resembling in some features viroids and satellite viruses found in plants.

Astroviridae

This is a family of small, single-stranded RNA viruses that are recovered from a wide variety of birds and mammals and are rarely associated with clinical disease. The name of the family comes from the appearance of viral particles under EM examination; some Astrovirus virions display a five or six-point star-like appearance.

Members of the Astroviridae are species-specific and included in a single genus, Astrovirus. Different antigenic types are recognized; specifically three types have been recovered from cattle and seven from humans.

Viral Characteristics

- The genome consists of a linear, positive-sense single-stranded RNA molecule.
- They are naked viruses with icosahedral symmetry (27 - 30 nm in diameter).
- Some virions possess a star-like appearance with five or six-point surface projections.
- Replication takes place in the cytoplasm and viruses are released by cell lysis.
- They have considerable resistance to heat and detergents.

Significance

Astroviruses were initially observed by electron microscopy examination of children's feces and were subsequently observed in feces of dogs, cats, sheep, cattle, swine, ducks, turkeys and other animals.

Mild gastroenteritis due to astroviruses has been reported in cattle and other domestic species. The disease associated with astroviruses is ordinarily self-limiting.

Mild gastroenteritis has been reported in avian species. Young ducks may develop an acute fatal hepatitis.

Astroviruses have also been implicated as a cause of a watery diarrhea in children. Astrovirus gastroenteritis is uncommon in adults; however, many adults have antibodies attesting to the ubiquity of the virus.

Laboratory diagnosis is based on observation of large numbers of astroviruses in feces by electron microscopy.

Glossary

Peplomers: Glycoprotein structures that protrude from the envelope surface; also known as spikes.

All rights reserved. This document is available on-line at www.ivis.org. Document No. A3428.1205

