# Morbillivirus (marine mammals) (Infection with)

Aetiology Epidemiology Diagnosis Prevention and Control
Potential Impacts of Disease Agent Beyond Clinical Illness References

## AETIOLOGY

### Classification of the causative agent

Morbilliviruses belong to the family *Paramyxoviridae*, and are enveloped, negative-sense single-stranded RNA viruses. Members of the genus *Morbillivirus* are able to infect a wide range of hosts to cause varied types of disease, many of which are severe.

Morbillivirus infections in marine mammals are often referred to as “distemper” because their clinical presentation resembles that of another morbillivirus, canine distemper virus (CDV). When discussing morbillivirus infections in marine mammals, it is important to consider the number of different specific viruses encompassed under that umbrella:

- Phocine distemper virus (PDV)
- Baikal seal morbillivirus (BSM); considered a strain of European CDV
- Striped dolphin morbillivirus (DMV)
- Porpoise morbillivirus (PMV)
- Some marine mammals are susceptible to CDV

### Resistance to physical and chemical action

| | |
|---|---|
| Temperature: | Steam cleaning is effective. |
| pH: | Not determined |
| Chemicals/Disinfectants: | Susceptible to a 1:30 bleach dilution, potassium peroxymonosulfate, accelerated hydrogen peroxide, and aldehydes with contact times over 10 minutes |
| Survival: | Environmental survival depends on ambient temperatures; colder temperatures prolong viability. |

## EPIDEMIOLOGY

### Hosts

- Seal species (*Phoca* spp., *Halichoerus* spp.)
- Harbour porpoises (*Phocoena phocoena*)
- Striped dolphins (*Stenella coeruleoalba*)
- Bottlenose dolphins (*Tursiops truncatus*)
- Pilot whales (*Globicephala melas*)
- Northern sea otters (*Enhydra lutris kenyoni*)
- Hawaiian monk seals (*Monachus schauinslandi*, a critically endangered species)
- Serologic evidence - but not documented clinical disease - of infection exists for a variety of other seal, porpoise, whale, and dolphin species.
    - There is also serologic evidence in walruses (*Odobenus rosmarus*), manatees (*Trichechus manatus latirostris*), and polar bears (*Ursus maritimus*).

### Transmission

- Droplet and aerosol transmission (respiratory route)
- Direct contact with infectious tissues or fluids

- Venereal and vertical transmission (via milk and *in utero*) is highly suspected to occur in cetacean species, but has not been documented.
    - Pinnipeds are also suspected to be capable of *in utero* infections.
- Mechanical transmission via fomite and arthropod exposure is suspected but not confirmed.

### *Sources*

- Virus is shed via the respiratory, dermal, urinary, gastrointestinal, and ocular routes.

### *Occurrence*

Morbilliviruses were first identified in marine mammals in 1987. There have been major epizootics documented in the following species and geographic regions since:

- Harbour seals (*Phoca vitulina*) and grey seals (*Halichoerus grypus*) in northwestern Europe (separate epizootics)
- Baikal seals (*Phoca sibirica*) in Siberia
- Striped dolphins (*Stenella coeruleoalba*) in the Mediterranean Sea
- Bottlenose dolphins (*Tursiops truncatus*) along the United States Atlantic coast

Recent sero-surveys indicate cetacean morbilliviruses may be distributed globally in many mammalian species.

Alterations in migratory patterns may contribute to viral spread; it is believed that there are populations and species in which enzootic morbilliviruses result in low mortality rates, and when they come into contact with an immunologically naive population, an epizootic can occur. The Baikal seal epizootic of 1987-88 likely occurred due to viral transfer of CDV to seals from terrestrial carnivores. Harp seals are purported reservoirs of PDV infection for hooded seals and walruses, and are believed to transmit the virus at shared whelping sites in the Atlantic Ocean.

Pinniped behaviours such as hauling out onto shore are considered risk factors for infection. The virus is more easily aerosolized, and individuals are likely to be in close contact with one another.

## *DIAGNOSIS*

After experimental infection with PDV, harbour seals became viraemic 5-12 days post-inoculation, and IgM was detected at 7 days post-inoculation. IgG was not produced until day 11. There was no correlation between antibody titre and recovery from infection.

A grey seal challenged with PDV successfully seroconverted but did not develop clinical signs or lesions. This, combined with historically lower mortality rates for this species during epizootics, suggests gray seals species may be less susceptible to clinical disease.

Baikal seals challenged with BSM seroconverted at 10-20 days post-inoculation.

### *Clinical diagnosis*

Infected seals often present with pyrexia, depression, serous/mucopurulent oculonasal discharge, conjunctivitis, dyspnoea, gastroenteritis +/- diarrhoea, cutaneous lesions, neurologic signs, and/or abortion. Subcutaneous tissues in the cervical and thoracic regions may become emphysematous and prevent animals from diving. Sea otters infected with PDV present similarly to pinnipeds.

Clinical disease in cetaceans is less understood. Reduced body fat stores are a common finding which likely impacts the buoyancy of the animal. Infected individuals may develop erosions on the buccal mucosa, an increased parasite burden, tachycardia, abnormal respiratory rates, muscle tremors, incoordination, and weakened vocalisation. Dolphins have been observed striking themselves against solid objects in the water with a reduced interest in swimming; these behaviours may indicate neurological damage.

Animals may become leukopoenic, with or without a lymphopenia. Haemoconcentration has also been documented in clinical cases. Cetaceans and pinnipeds may become stranded on land, too weak to return into the water.

## *Lesions*

- Bronchointerstitial pneumonia +/- pleuritis
    - Congested and/or oedematous tissue; lungs do not collapse and may have atelectatic foci.
    - Interlobular, subpleural, and mediastinal emphysema
    - Serofibrinous exudate with mononuclear cells in airways
    - Formation of intra-alveolar hyaline membranes with haemorrhage
    - +/- suppuration, abscess formation
    - Type II pneumocyte proliferation
- Lymphadenitis, lymphoid depletion and necrosis
- Ulcerative stomatitis
- Nonsuppurative encephalitis
    - +/- haemorrhage
    - Necrosis of neurons and glial cells
    - Perivascular cuffing
    - Astrocytosis
    - Microglial infiltration
    - Neuronophagia with focal demyelination
- Ophthalmitis
- Serosanguinous fluid in the thorax and/or abdomen
- Vaginitis/balanoposthitis
- Fibrosis of the lung, heart, liver, pancreas
- Cellular inclusion bodies, syncytia formation
- Comorbid nematode infections are common and may cause development of parasitic granulomas.

## *Differential diagnoses*

- Influenza
- Brucellosis
- Pasteurellosis
- Herpesvirus
- Calicivirus
- Lungworm infections
- Infectious gastroenteritis
    - Salmonellosis
    - Enteric parasites
- Algal bloom toxicity

## *Laboratory diagnosis*

**Samples**

*For isolation of agent*

- Tissues from the respiratory or gastrointestinal tracts, including pancreas
- Brain
- Renal pelvis and/or bladder epithelium
- Conjunctiva

- Mucosae (nasal, buccal, vaginal, preputial, urethral)
- Lymphoid tissue (lymph nodes, thymus, tonsils, spleen)

*Serological tests*

- Whole blood
- Serum
- Peripheral blood mononuclear cells (PBMC)

**Procedures**

*Identification of the agent*

- Immunoperoxidase or immunofluorescence staining
- Antigen capture enzyme-linked immunosorbent assay (ELISA)
- Nucleic acid hybridisation techniques (tissues only)
- Reverse-transcriptase polymerase chain reaction (RT-PCR)
    - Preferred method for autolytic tissues
- Virus isolation
    - May utilise Vero cells or seal lung, skin, or kidney cell lines
    - Inoculation of tissue extracts into dogs and cocultivation of PBMC may be utilised.
- Histology
    - Acidophilic nuclear and cytoplasmic inclusion bodies in cells from the respiratory tract, gastrointestinal tract, urinary tract, lymphoid tissues, and/or central nervous system is pathognomonic.

*Serological tests*

- IgM or IgG capture ELISA
- Virus neutralisation assays
- Plaque reduction assays

## *PREVENTION AND CONTROL*

### *Sanitary prophylaxis*

- The role of chemical contaminants (e.g., from industrial waste runoff) predisposing pinnipeds and cetaceans to clinical disease is highly debated. If practical and feasible, decontamination of wastewater before it is released may be helpful.
- In captivity, house animals with other animals of the same serologic status.
    - Quarantine all new animals before introduction to a group.
- If releasing marine mammals from captivity (such as from a rehabilitation center), do so as close to the animal's original location as possible. This helps reduce the probability of introducing virus to a naive population.
- Translocating marine mammals is not recommended.
- Interaction between marine and terrestrial mammals should be limited due to the risk of CDV transmission.
- Exercise proper disinfection methods in captive facilities and when performing field research.

### *Medical prophylaxis*

- Experimental vaccines have been developed, but their efficacy and longevity is not well determined.
    - It is believed inactivated CDV vaccines are effective in preventing PDV in captive pinnipeds.
    - Do not administer live vaccines to free-ranging mammals; live vaccines have induced mild respiratory disease in pinnipeds, and reversion to natural pathogenic status is a concern.

    - Studies are currently investigating vectored canarypox vaccine safety in harbour and Hawaiian monk seals.
- If an animal has a simultaneous heavy parasite burden, anthelmintic drugs may be indicated to improve prognosis.

## POTENTIAL IMPACTS OF DISEASE AGENT BEYOND CLINICAL ILLNESS

### Risks to public health

- There is no documented direct risk of marine mammal morbillivirus infection to humans.
- Marine mammals with morbillivirus infections are more likely to contract a secondary infection that may also be zoonotic to humans (e.g., salmonellosis, leptospirosis)

### Risks to agriculture

- Sheep (*Ovis aries*), cattle (*Bos taurus*), and goats (*Capra hircus*) have been experimentally infected with DMV and PMV. These animals are able to successfully seroconvert and may develop leukopoenia and pyrexia during the course of disease. No other significant clinical signs were noted, and the likelihood of these species contracting DMV or PMV is low.
    - Successful antibody production may interfere with testing for other morbillivirus infections such as Rinderpest or peste de petit ruminants viruses.

## REFERENCES AND OTHER INFORMATION


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The OIE will periodically update the OIE Technical Disease Cards. Please send relevant new references and proposed modifications to the OIE Scientific Department (scientific.dept@oie.int). Last updated 2019. Written by Marie Bucko and Samantha Gieger with assistance from the USGS National Wildlife Health Center.