World Organisation for Animal Health
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INFECTION WITH CARP EDEMA VIRUS (CEV)

PATHOGEN INFORMATION

1. CAUSATIVE AGENT

1.1. Pathogen type

Virus.

1.2. Disease name and synonyms

Infection with carp edema virus (CEV).

1.3. Pathogen common names and synonyms

Carp edema virus (CEV), koi sleepy disease syndrome (KSD).

1.4. Taxonomic affiliation

Carp edema virus is an unclassified pox virus of the Family Poxviridae.

1.5. Authority (first scientific description, reference)

CEV was first detected in Japan in the 1970s (Murakami et al., 1976).

The genome of CEV was published in NCBI GenBank (accession No. LC61308) (Meketa et al., 2021).

1.6. Pathogen environment (fresh, brackish, marine waters)

Fresh water.

2. MODES OF TRANSMISSION

2.1. Routes of transmission (horizontal, vertical, indirect)

Co-habitation studies have demonstrated that direct horizontal transmission is an important route of transmission. As gills are the main organ for CEV replication (Adamek *et al.*, 2017) vertical transmission is unlikely. The biophysical characteristics of the virus are not well understood, so it is difficult to determine the significance of indirect transmission by fomites.

2.2. Reservoir

Infected populations of fish, both farmed and wild, are the only established reservoirs of infection.

2.3. Risk factors (temperature, salinity, etc.)

Disease has been associated with international trade thus may be associated with stress.

Disease was originally considered to occur at temperatures between 15°C and 25°C (Miyazaki *et al.*, 2005); however, disease has also been reported at lower temperatures (Way *et al.*, 2017).

3. HOST RANGE

3.1. Susceptible species

Common carp *(Cyprinus carpio)* and koi *(Cyprinus carpio koi)* are susceptible to CEV, and other species are potential vector of CEV (Adamek *et al.*, 2017), such as bleak *(Alburnus alburnus)*, crucian carp *(Carassius carassius)*, European perch *(Perca fluviatilis)*, Prussian carp *(Carassius gibelio)*, roach *(Rutilus rutilus)* and tench *(Tinca tinca)*.

3.2. Affected life stage

Outbreaks have been observed in both juvenile and adult koi and common carp.

3.3. Additional comments

There is some evidence that certain genetic strains of carp are more resistant to infection with CEV and koi carp are the most susceptible (Adamek *et al.*, 2017).

4. GEOGRAPHICAL DISTRIBUTION

Infection with CEV has been reported in Europe (Way & Stone, 2013; Haenen *et al.*, 2014; Jung-Schroers *et al.*, 2015; Lewisch *et al.*, 2015; Matras *et al.*, 2017; Adamek *et al.*, 2018), North America (Hedrick *et al.*, 1997; Lovy *et al.*, 2018; Stevens *et al.*, 2018), South America (Viadanna *et al.*, 2015) and Asia (Swaminathan *et al.*, 2016; Zhang *et al.*, 2017; Kim *et al.*, 2018; Ouyang *et al.*, 2018).

5. CLINICAL SIGNS AND CASE DESCRIPTION

5.1. Host tissues and infected organs

The main organ where pathology is observed is the gills (Adamek *et al.*, 2018).

5.2. Gross observations and macroscopic lesions

The primary behavioural sign is lethargy and unresponsiveness while gross lesions include swollen gills or gill necrosis, enophthalmos, skin lesions at the base of the fins or around the mouth and inflammation of the anus (Jung-Schroers *et al.*, 2015).

5.3. Microscopic lesions and tissue abnormality

Histologic lesions are found primarily in the gills with a hyperplasia and clubbing of secondary gill lamellae with partial or total occlusion of the interlamellar space. Edema is seen in the epithelial cells in secondary filaments with detachment of epithelial cells. Additionally, mild infiltration of the gills with eosinophilic granular cells is found (Adamek *et al.*, 2017; Jung-Schroers *et al.*, 2015).

5.4. WOAH status

Infection with CEV is no longer considered to meet the WOAH definition of an 'emerging disease'.

6. SOCIAL AND ECONOMIC SIGNIFICANCE

The common carp *(Cyprinus carpio)* is one of the most widely cultured freshwater fish. In 2019 global production included 4.5 million tons, of which 97% originated from aquaculture (FAO, 2021). Introduction of the virus has been shown to cause significant mortality (Wen *et al*., 2017; Zhang *et al*., 2017) and can also impact wild populations (Lovy *et al*., 2018).

7. ZOONOTIC IMPORTANCE

None.

8. DIAGNOSTIC METHODS

8.1. Definition of suspect cases

High levels of lethargy and mortality in carp, associated with gill edema and necrosis, should be considered suspicious of infection with CEV.

8.2. Presumptive test methods

Several PCR methods for CEV detection are reported, including CEFAS end-point PCR (Matras *et al*., 2016), Oyamatsu's end-point PCR (Oyamatsu *et al*., 1997), CEFAS qPCR (Matras *et al*., 2016), TiHo probe qPCR (Adamek *et al*., 2016) and TiHo SYBR Green qPCR (Adamek *et al*., 2017).

8.3. Confirmatory test methods

Cefas qPCR and endpoint PCR show best performance for CEV detection (Adamek *et al*., 2017).

9. CONTROL METHODS

Restrictions on the movement of carp from farms and fisheries where the virus is known to occur will limit the spread of the disease. Generic biosecurity measures to minimise the spread via equipment, vehicles or staff (i.e. cleaning and disinfection) should also be implemented. Appropriate disinfection protocols should be incorporated into biosecurity procedures.

Mortality of carp infected with CEV can be significantly reduced when infected fish are immersed in a 0.5% saline bath (Seno *et al*., 2003).

10. TRANSMISSION RISK

As CEV has been horizontally transmitted through cohabitation, disease transmission is likely with movement of live aquatic animals. Current evidence suggests that the gills are likely to contain highest concentrations of CEV and thus effluent is likely to be contaminated.

11. ADDITIONAL USEFUL INFORMATION

For a recent review of CEV see:

MACHAT, R., POJEZDAL, L., PIACKOVA, V. & FALDYNA, M. (2021). Carp edema virus and immune response in carp (*Cyprinus carpio*): Current knowledge. *Journal of Fish Diseases*, **44**, 371-378. https://doi.org/10.1111/jfd.13335

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