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Letter to Editor

Waterborne Enteroviruses as a Hazard for Human Health

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Abstract

Spreading routes of enteroviruses (polioviruses, coxsackieviruses, echoviruses, unclassified enteroviruses and new genus - Hepatovirus), their survival in different water environments, the hazard from them for human health, and diseases caused by them are described. A list of enteroviral diseases is included.

Keywords: aquatic enteroviruses, health hazard, enteroviral diseases.

The aim of the present report is to emphasise the hazard for human health from enteroviruses transmitted by the water and alimentary route. Currently, descriptions of all enteroviruses and characteristics of enteroviral diseases can be found only in professional textbooks on medical virology.

Surface waters and tap water qualities determine one of the chief world problems, because in recent years in both developed and developing countries water qualities have continued to deteriorate [1]. Enterovirus bearers are sewage, sewage sediments, rivers receiving sewage [2, 3, 4, 5, 6], as well as treated sewage [7, 8, 9]. The sources of enteroviruses may be groundwaters [10, 11], coastal river waters [12, 13], coastal marine waters [13], aerosols emitted from sewage treatment plants [3, 5] and from solid waste landfills [14], soils [15] and insufficiently treated drinking water [16, 17, 18, 19].

Humans are the only known reservoir of enteroviruses. They survive in human feces for a long time and through contact they contaminate hands, utensils, food, water, milk, etc. This is why it is of very great significance to keep strict personal hygiene. The migration of enteroviruses from the source to drinking water runs along the following paths:

- ill human —> human feces —> sewage —> wastewater treatment plant —> river water receiving sewage —> water intake —» water treatment process —> tap water [5].

The waterborne enteroviruses group belongs to the *Picornaviridae* family. Their sizes are very small ranging up to 22-30 nm in diameter (Fig. 1). They are inactivated at temperatures of 55°-60°C over a period of 30 minutes. Enteroviruses are sensitive to formaldehyde, hydroxylamine, UV and ionizing irradiations as well as to acridine dyes and ozone. They are resistant to lipid solvents, pH 3-10, sewage treatment plant conditions and conventional chlorination [14, 17].

The results of investigations on both survival and quantitative content of enteroviruses in water environments are different because they depend on temperature, insolation, pH, humidity, season, method used and enteroviral genus. According to Klein, poliovirus survives in river water for 6-7 months [17], and to other authors polioviruses, coxsackieviruses and echoviruses keep their infecting ability for 2-6 month at temperatures 4° - 10°C [20]. In frozen water (ice, snow) enteroviruses survive 4-6 months [21]. In marine water polioviruses, coxsackieviruses, echoviruses and *Hepatitis A Virus* (HAV) survive for several months [11, 14] and analogically in groundwater [11].

From the results of quantitative determinations of enteroviruses some values are given below in PFU[1]/dm^3:

[1] PFU: Plaque Forming Unit (unit forming viral plaque on solid medium).

- in sewage 120 - 9 140 [17],
- in treated sewage 2 - 353 [17],
- in treated sewage 500 [5],
- in river water 18-283 [17],
- in treated sewage during poliomyelitis epidemic 2,000 - 5,600,
- in treated sewage during epidemic at the end of summer 100,000 - 210,000 [5].

Since enteroviruses are more resistant to disinfectants than *Escherichia coli* and coliform bacteria bacteriological standards using fecal coliform indicators as a monitor of the absence of viruses in water do not adequately reflect the potential transmission of viral diseases [14, 22]. This problem is solved by WHO guidelines and national regulations [16]. Enteroviral diseases occur most frequently in summer and early autumn. Table 1 shows waterborne enteroviruses and the diseases they cause.

The disease named poliomyelitis has been known since prehistoric times. It causes one or more terrible diseases by attacking the central nervous system and destroying motor neurons. However, some poliovirus infections may be symptomless [14, 23]. For many years effective vaccines have been used. In Poland oral attenuated vaccine is applied [23].

Coxsackieviruses, beside other illnesses, are most often connected with human heart diseases. There are no vaccines or antiviral drugs currently available for prevention or treatment of diseases caused by coxsackieviruses [14, 23].

Echoviruses infect people very easily through the alimentary tract, but they are usually less pathogenic than coxsackieviruses. More than 30 serotypes are known, from which 12 pothogenic have been classified as for humans. There is no vaccine available [14, 23].

Unclassified enteroviruses marked with the numbers 68, 70 and 71 have not been examined extensively so far. Enterovirus 68 has been isolated from the respiratory tract of children with bronchiolitis, enterovirus 70 from a patient with acute hemorrhagic conjunctivitis, and enterovirus 71 from patients with meningitis, encephalitis or paralysis resembling poliomyelitis [14].

Hepatitis A Virus (HAV) is widespread throughout the world and hepatitis A disease is the most commonly described in the group of viral hepatities transmitted by the fecal-oral route. Under poor living and sanitary conditions outbreaks of hepatitis A disease in families and military troops have been observed [23]. HAV has been detected not only in different natural waters, but also in oysters from coastal water [24]. The consumption of raw oysters or other clams from rivers polluted with sewage has resulted in several hepatitis A epidemics [14].

HAV is more resistant to usually used disinfectans than other picornaviruses and therefore special precautions in dealing with patients and medical utensils must be taken [14, 23]. HAV is resistant to 20% ether, acidity (pH 1.0 for 2 h) and heating to 60°C for 1 h. Its destruction is possible by autoclaving at 121°C for 20 minutes, by boiling in water for 5 minutes and by dry heating to 180°C for 1 h. Safe and effective vaccines have been prepared and recommended for children over 2 years of age [14].

How can enteroviral infections be avoided? Consider the following preacautions:

1) keep strict personal hygiene,
2) apply vaccines if available,
3) during epidemics drink boiled water or water fil tered through commercial filters,
4) avoid staying in crowded places such as buses, trams, cinemas, theaters,
5) for sewage treatment use only highly effective methods,
6) for water treatment use adequate disinfectants with effective doses as recommended by national regulations [14, 16, 25], and follow WHO guidelines [16, 26].

Scientists from different countries recommend using and developing methods based on molecular techniques for virus detection [1].

Table 1. Enteroviruses and enteroviral diseases [14, 23].

Name	Diseases that occur or may occur
Polioviruses, types 1-3	Poliomyelitis (Heine-Medin disease, infantile paralysis, paralysis), meningitis, nonparalytic polyomyelitis
Coxsackieviruses Supgroup A, types 1-24	Common colds, bronchitis, pharyngitis, infantile pneumonia, meningitis, gastroenteritis, hepatitis, herpangina (vesicular pharyngitis), pleurodynia (acute febrille disease of pleura), acute hemorrhagic conjunctivitis, exanthem
Coxsackieviruses Supgroup B, types 1-6	Common colds, bronchitis, pneumonia, gastroenteritis, hepatitis, pancreatitis, diarrhea in children, meningoencephalitis (inflammation of brain meninges and brain), myocarditis, pericarditis, pleurodynia, myalgia (pain of muscles, abdominal wall and headache), epidemic myositis (epidemic inflammation of muscles), herpangina, exanthem
Echoviruses, types 1-33	Common colds, bronchitis, febrille illnesses with or without rash, encephalitis, myositis
Enteroviruses marked with numbers 68, 70, 71	68: bronchiolitis (disease of bronchioles) 70: acute hemorrhagic conjunctivitis 71: meningitis, encephalitis, paralysis rasembling poliomyelitis
Enterovirus 72 – *Hepatitis A Virus* Hepatovirus – new genus – HAV	Hepatitis A, gastroenteritis

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