LECTURE 8

BIOLOGICAL WATER POLLUTION IMPACT ON HEALTH

HYDRIC PATHOLOGY

Diseases caused by water, also known as hydric diseases affect large numbers of people, wearing the character of a mass expansion diseases. Biological Pollution of water sources is known a long time and has control and surveillance methods. Basically this phenomenon remains unresolved due to the action of factors which determine and updates biological pollution.

These socio-economic factors arose due to new relationships between man and the environment, among the most important are:

- development of international relations on the basis of economic, social, cultural, tourism will strengthen human movement;
- enhancing international trade in food, means of circulation of biological agents;
- development of livestock farms, way intense biological pollution of the environment;
- intense chemical pollution of water, the resistance change characteristics of biological agents in the environment;
- antibiotic therapy, as selective precursor of multiple resistant strains.

All these factors have favored the import, distribution and survival of biological agents.

Forms of manifestation

Infectious diseases transmitted by water can have many manifestations in the number of diseases: epidemic, endemic and sporadic.

**Epidemic** is the main form of manifestation of waterborne diseases and has the following characteristics:

- the emergence of a large number of diseases in areas where people rely on the same source of water supply;
- affected all susceptible persons regardless of sex, age, occupation, economic level, people who consumed contaminated water source;
- water during the outbreak has features nepotabilitate;
- epidemic ceases as a result of measures for water;
- may occur a number of cases are transmitted by contact (tail epidemic).
**Endemic** is manifested by the presence of a small number of diseases, with fatal non-periodic and permanent in a particular geographic area.

Normally geographical area gets together with a poor level of living and hygiene / sanitation. Endemic form occurs frequently in human communities that consume surface water that has not been treated previously.

**Sporadic** form is manifested in terms of isolated cases; it is not a specific form of expression for the fluid path.

**MICROBIAL DISEASES TRANSMITTED BY WATER**

**Typhoid and paratyphoid fever**

The water can transmit minor salmonellosis - an infection caused by various types of Salmonella. Typhoid fever is no longer a major health problem due to general hygiene measures and vaccination anti typhi. Surface waters are frequently contaminated with *Salmonella* serotypes. Contamination is through droppings or urine (sick or carrier) or domestic wastewater discharges contaminated.

**Cholera**

Fluid is transmitted at a rate of 99%. Predominant are species *El Tor*. Spread of the disease is mainly related to drinking water contaminated water used for irrigation wastewater. Occur frequently: lack of sanitation, insufficient water quantity. *El Tor* vibrios shape of gravity lower, but can remain carriers.

**Dysentery**

Mixed epidemics have been described *Shigella dysenteriae* and *Salmonella typhi* products. High incidence can be explained by contamination of the environment, including water basins by carriers or patients. Population is greater receptivity by lack vaccine. Clinical forms of the disease are mild.

**Enteritis and enterocolites**

Etiologic agents: *Campylobacter jejuni and coli*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Proteus*, *clostridia*, *Yersinia enterocolitica*. Tank - birds, sheep, pigs.

**Leptospirosis**

Anthropozoonosis reservoir of this infection is the rats, mice. Other species - animals that eliminates tank role during disease leptospires in urine and droppings, passing into surface waters. Diseased animal carcasses are a source of infection. Man becomes contaminated by bathing in contaminated water crossing during fishing by drinking water or irrigation.

**Tularemia** is an anthropozoonosis caused by rodents. Water contamination is done by urine and feces of sick and dead animals. Man becomes contaminated by bathing.

**Brucellosis** is common in pigs, cattle. Water contamination is achieved by feces and urine from sick animals. Variable survive in water for a while.
Tuberculosis - Koch bacillus is found in surface water polluted with sewage from tuberculosis sanatoriums. Disease has been described by bathing in heavily polluted waters.

**VIRAL DISEASES TRANSMITTED BY WATER**

Man removes by dejection more than 100 viruses. Deep waters are protected from viral pollution, the groundwater is contaminated, are most heavily polluted surface waters.

Virus illness has certain characteristics:
- exhibit polymorphic (digestive, respiratory, skin, nervous);
- existing methods do not allow immediate isolation of viruses from water;
- there is a mismatch between the viruses in water and morbidity.

Survival of viruses in water is 150-200 days, many of which are resistant to chlorine doses commonly used. In this context water "drinking" in terms of bacteriological can transmit viral infection.

### TABLE I

**Water-borne viruses**

<table>
<thead>
<tr>
<th>VIRUS GROUPS</th>
<th>HEALTH DAMAGES OR TO BE ASSOCIATED</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Enterovirus</strong>: polio</td>
<td>paralysis, meningitis, fever, respiratory diseases, diarrhea, myocarditis, encephalitis, acute hemorrhagic conjunctivitis</td>
</tr>
<tr>
<td>Coxsackie A</td>
<td></td>
</tr>
<tr>
<td>Coxsackie B</td>
<td></td>
</tr>
<tr>
<td>echo enteroviruses</td>
<td></td>
</tr>
<tr>
<td><strong>Hepatitis A</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Gastroenteritis Type A</strong> (Norwalk agent)</td>
<td>vomiting, diarrhea, fever</td>
</tr>
<tr>
<td><strong>Gastroenteritis Type B</strong></td>
<td>respiratory disease and mild diarrhea, vomiting, diarrhea, especially in children under 6 years</td>
</tr>
<tr>
<td>rotavirus</td>
<td></td>
</tr>
<tr>
<td>reovirus</td>
<td></td>
</tr>
<tr>
<td><strong>Adenovirus</strong></td>
<td>acute respiratory disease, infection conjunctivitis, keratitis, encephalitis, tumors</td>
</tr>
<tr>
<td><strong>Polyomavirus</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Parvovirus</strong>: adeno-associated virus</td>
<td>virus adeno-associated acute respiratory disease of children</td>
</tr>
</tbody>
</table>

**PARASITIC DISEASES TRANSMITTED BY WATER**

**Diseases caused by protozoa**

Amoebiasis and dysentery caused by Entamoeba histolytica ambiană affects the colon, liver and other organs secondary. Had especially in hot countries. Infectious forms cysts that are removed in the external environment with the faces of patients or carriers. Ingestion of cysts infesting man with food, water or contaminated hands.
Giardiasis or lambliaisis is caused by *Lamblia intestinalis*. The parasite is widespread in tropical and temperate regions. Infectious forms cysts that can withstand wet months. The organism develops, especially in the duodenum and bile ducts. Although food and water presents a risk of illness, contact with infected person is the main mechanism of transmission.

Balantidiosis or dysentery caused by *Balantidium coli*. Has a low incidence, disease is spread through water or food as they have been removed from the human parasite cysts or pork. Disease manifests itself as chronic diarrhea or develops symptoms.

The incidence of trichomoniasis increases in summer by using tanks and swimming pools. It is a parasitic venereal disease cause by *Trichomonas vaginalis*.

Diseases caused by cestodes

Cysticercosis is caused by *Cisticercus cellulosae* (solium larval form of Taeniei) and less *Cisticercus bovis* (larval form of *Taenia saginata*). Man removes parasites called embriofors infectious forms that can be swallowed with water or contaminated food. Embriofors environment can withstand up to 1-2 months and once they get in the stomach they crosses gastric mucosa the blood or lymph. It locates in the eye, brain, muscle, skin.

Echinicosis or hydatid cyst is caused by the larval form of *Taeniei echinoccocus*. Reservoir of parasites: dog, wolf, cat. Infectious for humans and animal forms are embrioforii fishing contaminating land, water sources and can infest animals that serve as intermediate host. Transmission to humans is by hands, water, fruits, vegetables contaminated with parasite eggs. Stomach, embriofors go into circulation, reach the liver, lungs or other organs.

Brain Cenurosis caused by *Cenurus cerebralis*. Human infestation is digestive through water, vegetables; foods have embriofors parasites removed by the dog or other definitive host. In humans it acts as a brain tumor.

Human himenoleptidosis is caused by *Himenolepis nana*. It can be transmited through water in addition to food and contaminated hands.

Disease caused by trematodes

Liver fasciolosis is caused by *Fasciola hepatica*. Tank: sheep, goat, cattle, pig, horse, dog, squirrel, man. Man is the definitive host. Parasite laid eggs at 10-12 weeks after entering the definitive host. Complete cycle lasts at least 150 days animal. Removing eggs by humans and animals is approximately 3 months after infestation, time required for parasite maturation.

Intestinal bilharziosis or schistostomiasis is caused by *Schistostoma mansoni*. The tank is the man sick or healthy carrier that eliminates eggs. Human infestation: dermal, digestive. In the body cercariae lung and heart turn to the left and then to the general circulation. Schistostomei normal habitat is venous blood. Other sites: lung, intestine, biliary.

Diseases caused by nematodes

Transmission mechanism is closely related to evolutionary cycle of the parasites included in this group. For some water is a passive vector while the others have an active role.

Soil transmitted helmintiasis includes: *Ascaris lumbricoides, Trichocephalus* disappear *Strongiloides stercoralis*. In epidemiology of soil transmitted helmintiasis soil is the main medium of these parasites, water is only an way accidental.

Philariasis can be dermal lymphatic and / or cavitary. Parasites live in the lymphatic pathways in humans and some animals.
CENTRAL SUPPLY WATER FACILITY

Central water supply is a set of facilities for the collection, transport, correction quality, storage and distribution of drinking water.

Capture is achieved through strainers placed upstream sources of pollution and population centers in areas where water flow is sufficient strainer is placed in the central axis of the water at least 0.5 m below the water level and at least 0.7 m above the bed (for surface waters). Groundwater sources are used for dug wells or drilled placed upstream of population centers or industrial areas.

The treatment is the necessary procedures to remove items that make water drinkable: sedimentation, filtration and disinfection.

**Sedimentation** involves the removal of suspension. Depending on their concentration can be simple sedimentation or coagulation.

- simple sedimentation takes place in cement tanks (horizontal or vertical) in which water flows with a low rate (5-9 mm / second). Suspended particles are deposited due to gravity sedimentation is influenced by the flow velocity, basin shape, temperature, particle size. Simple sedimentation has an efficiency of 40-60% of the content of suspensions.
- sedimentation with coagulation is used in the presence of high turbidity and an increased amount of colloidal suspensions. Is the coagulant aluminum sulfate, ferrous sulfate, ferric chloride or ferric sulfate. The most commonly used aluminum sulfate in solution and in different strengths depending on the density of the suspension. The mechanism of action is the formation of aluminum hydroxide, which involves suspension of rushing water storage. Coagulant enters the reaction chamber placed before the sedimentation tank. Sedimentation with coagulation efficiency can reach 60-80%.

**Filtration** involves passing water through materials with pores that retain suspension, organic materials and microorganisms. Retention is achieved both through mechanical action and by the biological membrane is formed due to the filter surface.

- slow filters are the sand-cement tanks. Water filtration speed is slow (3-4 m³ / m² / day), retaining carried out both mechanically and biologically. Biological membrane is formed from plant and animal organisms whose efficiency is increased. Slow filtration efficiency reached 99.9%, but the resulting water quantity is low.
- fast filters are pools of cement with sand filtering the flow reaches 200-300 m³ / m² / day. Biological membrane is shallow, rapidly forms and is poor in oxidizing microorganisms. Retention is mainly mechanical, the biological being less effective. The efficiency of this filter is 80-95% but is usable for large amounts of water.

Disinfection involves removing microorganisms from water. Disinfected destroy pathogens and saprophytes to reduce the limit for drinking. Disinfection is achieved by chemical and physical methods.
**Disinfection by chemical methods**

Chemical disinfection is based on bacteriostatic and bactericidal effect of strong oxidizing substances (chlorine, ozone).

**Water chlorination**

Chlorination of water is cheap and effective.

The mechanism of action is the oxidation process conducted by hypochlorous acid and hypochlorite ion:

\[
\text{Cl}_2 + \text{H}_2\text{O} \rightarrow \text{HOCl} + \text{HCl}
\]

\[
\text{HOCl} \rightarrow \text{H}^+ + \text{OCl}^-
\]

At pH values below 7 hypochlorite ion formation is reduced while the seven values hypochlorite ion is found in large quantities. Hypochlorous acid and hypochlorite ion have a cleansing effects.

Chlorine reacts with organic matter in water first and then act on bacteria.

Reaction with chlorine compounds organic material: monochloramine, dichloramine and trichloramine compounds with a weak disinfectant, manifested in time.

In disinfection is important to know the dose of chlorine to be calculated so that after oxidation of organic matter remain a surplus of free chlorine as hypochlorous acid and hypochlorite ion, free chlorine residual amount of 0.1 to 0.2 mg / l that it reaches the distribution network.

Disinfection involves the breaking point exceeded the point where all organic substances are oxidized, after reaching breaking point or inflection free residual chlorine has an upward trend.

From this point of view proper disinfection involves the four steps include: destroying chlorine in organic compounds, chlorinated compounds formation, destruction of chlorinated compounds and free residual chlorine production.

Disinfectant action depends on the conditions under which this process takes place and the particular microorganisms.

Conditions in which the process include:

- chlorine consumption represents water capacity to consume chlorine by reaction with organic matter;
- temperature - disinfection is effective hot water;
- pH water - bactericidal effect increases with decreasing pH;
- contact time - is at least 30 minutes, but his growth increases efficiency;
- chlorine dose used - depends on the efficiency of all plant departments and varies between 0.8 and 1.0 mg / l
- destruction of microorganisms depends on hypochlorous acid and hypochlorite ion to combine with cellular components. Chlorinated compounds acting on enzyme systems, particularly those containing -SH groups that lock. Destroying germs is faster or slower, depending on sensitivity (depending on species).
Chlorination has its advantages are that it is cheap, efficient and applicable to large amounts of water, generates chlorine free and bound.

**Disadvantages of chlorination**
- water gives particular taste and smell of medicine, by reacting chlorine with phenols resulting chloro-phenol water giving iodoform taste;
- irritating effect on gastric mucosa and inhibit the pepsin;
- the reaction with organic substances resulting trihalomethanes (a carcinogenic effect);
- not effective for some viruses and protozoan cysts.

**Water ozonation**
Ozone is a greenhouse gas more potent oxidant than chlorine reacts with organic matter faster (minutes) produces no odor or flavor of phenol, bleach and deodorizes water action is not affected by temperature and pH bactericidal effect is Powerful and fast, destroying pathogenic flora of water and reducing saprophytic flora, bacteria spores, viruses and bacteriofags; dose is 0.5-1 mg / l, ozonation is made by mixing water with ozone produced when disinfection, ozone dissolved in water decomposes spontaneously:
\[ O_3 \rightarrow O_2 + [O] \]

Incipient state oxygen has strong oxidative properties, alas excess ozone persists, but is excreted molecular oxygen in the atmosphere.

**Disinfection by physical methods**
- disinfection with ultraviolet wavelength of 250-260 nm layer of water passing through the lamp must be thin, and the water will have a low turbidity, bacteria are bactericidal or bacteriostatic destroyed by (depending on dose); to achieve good efficiency bactericidal dose should be applied;
- ionizing radiation (gamma rays) have high penetration and low ionizing action, acts by oxidation accompanied by the release of free radicals acting oxidant water disinfection subject should be well clarified, since the presence of organic substances has a protective effect for radicals free oxidants;
- ultrasound is produced by generators that converts electrical oscillations in mechanical oscillations degrade the superficial layers of cells; disinfectant effect depends on the intensity oscillations, increasing their number; commonly used piezoelectric oscillator with a frequency of 100,000 vibrations / second; destruction bacteria is achieved by superficial cell damage by ultrasound, the cells remain sensitive to subsequent oxidant effect of some substances.

**Storage** is done in much larger tanks that provide water supply for 24 hours and air tanks are underground placement.

The distribution sector is the pipe that carries water from the reservoir to housing; pipes are cement, iron, steel, cement, water flows under pressure, they are placed below the frost and above the sewer.

Perimeters of protection is placed around areas or sources of water supply facilities, within which measures are taken to limit pollution. Health are protected from surface water
sources used for power plant, pumping stations, pipes, treatment plants, storage tanks and distribution networks.

There are two areas of protection:
- perimeter strict diet;
- restricted area.

Surface water specific perimeters
- severe regime perimeter is elongated at capture is marked terminals on the water surface with dimensions of at least 100 m upstream and 25 m downstream outlet and lateral in this area is prohibited discharge of solid or liquid waste, organized or unorganized;
- restriction perimeter is placed outside the strict regimen and has varying sizes depending on hydro geological features of the natural basin, is calculated so that any pollution is neutralized by the intake of water is forbidden to use this site substances fungicides, insecticides or other sources of pollution.

Groundwater specific perimeters
- strict regime perimeter has a circular shape with a variable extent depending on the geological structure of the land, shall be compiled pollution to travel any distance at least 20 days during which major enteric bacteria are destroyed, the minimum distance upstream catchment is 50 m, the land on which manure is prohibited substances, plant protection, irrigation, livestock grazing, drilling, excavation;
- restriction perimeter extends outside the strict regime and possible pollution will go 50 days to the extent strict regime zone, is marked terminal.

Central facilities only strict diet perimeter of 20 m with a concentrated form is enclosed with exterior walls.

The supply lines were severely regime perimeter of 30 m from any potential source of pollution. The distribution network has a perimeter of severe regime of 3 m from the sewage pipe or absorbent wells.

REFERENCES