Kushnereva T.V.,
Candidate of Medical Sciences, Associate Professor,
Associate Professor of the Department of Pediatrics № 2
Ukrainian Medical Dental Academy

Pikul K.V.,
Candidate of Medical Sciences, Associate Professor,
Associate Professor of the Department of Endocrinology
with Childhood Infectious Diseases
Ukrainian Medical Dental Academy

Prylutskyi K.Iu.,
Candidate of Medical Sciences,
Assistant of the Department of Endocrinology
with Childhood Infectious Diseases
Ukrainian Medical Dental Academy

Chebotar O.V,
Doctor-Intern in the Specialty "Pediatrics"
Ukrainian Medical Dental Academy

CURRENT STATUS OF POLIO VACCINATION IN CHILDREN

The Polio Eradication Initiative for 2019-2023 contains non-epidemic, poliovirus-infected high-risk countries, including Ukraine, India, Ethiopia, Uganda and other African countries. The most important tasks facing Ukraine are to help strengthen the health and immunization system against polio, stop the spread of all wild polioviruses, all outbreaks of circulating polioviruses of the vaccine origin and eliminate the risk of their occurrence in the future.
Key words: poliomyelitis, children, vaccination.

В Стратегії по завершенню ліквідації поліомієліту на 2019–2023 рр. зазначені неендемічні країни, що отримали оцінку «високий ризик» по розповсюдженню поліовірусу, серед яких є Україна, разом з Індією, Ефіопією, Угандою та іншими африканськими країнами. Найважливішими завданнями, поставленими перед Україною, є сприяти зміцненню системи охорони здоров'я та імунізації проти поліомієліту, зупинити поширення всіх диких поліовірусів, всі спалахи циркулюючого поліовірусу вакцинного походження, усунути ризик появи їх у майбутньому.
Ключові слова: поліомієліт, діти, вакцинація.

В Стратегии по завершению ликвидации полиомиелита на 2019-2023 гг. указаны неэндемичные страны, которые получили оценку «высокий риск» по распространению полиовируса, среди которых Украина, вместе с Индией, Эфиопией, Угандой и другими африканскими странами. Важнейшими задачами, поставленными перед Украиной, являются содействие укреплению системы здравоохранения и иммунизации против полиомиелита, остановить распространение всех диких полиовирусов, все вспышки циркулирующего полиовируса вакцинного происхождения, устранить риск появления их в будущем.
Ключевые слова: полиомиелит, дети, вакцинация.

Revalence of the topic. Polio is a viral disease that is easily spread in the absence of immunization and is still a challenge for modern health care worldwide. Polio eradication is a goal of paramount importance, as long as polio exists, children in all countries remain at risk. Clinically, approximately 1 in 200 children (<1% of poliovirus infections among susceptible people) develop paralytic polio. Clinical signs of the disease without paralysis, characterized by fever for several days, malaise, drowsiness, headache, nausea, vomiting, constipation or angina occur in 4-8% of people infected with poliovirus.

Asymptomatic infection is the most common clinical form (90-95%) of poliovirus infection in susceptible humans. It is this largest group of infected viruses that secrete a fecal virus that is a serious problem in the transmission of infection [5].

As part of World Polio Day 2019, an independent panel of experts has concluded that wild poliovirus type 3 has been eradicated worldwide. The last case of wild poliovirus type 3 was detected in northern Nigeria in 2012.

The wild poliovirus type 3 is the second strain of polio virus to be eliminated after certification for the elimination of wild poliovirus type 2 in 2015. Destruction of these strains is an important achievement, an incentive for the last step the essence of which is the elimination of wild poliovirus type 1, which is found only in Afghanistan and Pakistan [7].

In Ukraine cases of vaccine-associated paralytic polio in children were recorded in 2015, 2017 and 2019. The last confirmed case was recorded in an unvaccinated two-year-old child in the Volyn region. It is known that the coverage of vaccinations below 90% loses the main function of vaccination – the formation of collective immunity; vaccination rates were particularly critical in 2014 (44.7% of children vaccinated).

The result of this trend was the formation of vaccine-related variants of poliovirus. Three strains of

vaccine-related variants of poliovirus type 2 were detected in 2014, and in 2015, two cases of poliomyelitis caused by circulating vaccine-related variants of poliovirus type 1 were reported. In response to the outbreak, 3 rounds of childhood vaccination with oral polio vaccine (II round, age group 2 months – 6 years; III round – 2 months – 10 years) were conducted in October 2015 – February 2016 with coverage levels, respectively 64.4%, 71.7% and 80.7%.

The measures made it possible to improve vaccination coverage (some children under 1 year of age received 3 vaccinations: inactivated + oral vaccine), which was 90.1%. At the same time, in 10 administrative regions these figures were below 90%.

Formulation of the problem. Due to the Strategic Plan for Polio Eradication and the Final Elimination Phase 2013–2018, successful eradication of wild poliovirus and circulating poliovirus of vaccine origin was carried out. The latter is still causing outbreaks in various countries in Africa (Democratic Republic of the Congo, Nigeria, Niger, Somalia, Papua New Guinea) [3; 6]. As long as poliovirus transmission is not interrupted, all countries remain at risk, especially those with inadequate health care and immunization. The 2019–2023 Initiative identifies three major obstacles to achieving the global elimination of wild poliovirus: 1) insecurity and military conflicts, forcing families to move massively to refugee camps or internally displaced persons; 2) weak or vulnerable health care systems where families do not have access to basic health care.

In these circumstances, large groups of children are not immunized or under-immunized, thereby increasing the risk of prolonged circulation and outbreaks; 3) operational, managerial and resource risks – refers to the inability to maintain emergency preparedness, function effectively at peak times, lack of human resources, financing, etc. [3].

The purpose of the article is actualization of the problem of polio vaccination in children; physicians' tactics to prevent morbidity in the pediatric population, timely detection of wild poliovirus circulation and diagnosis of vaccine-related variants of poliovirus.

Basic material. In 2019 Afghanistan and Pakistan were the only endemic countries to report 34 cases of wild poliovirus transmission due to political conflicts, instability combined with poor infrastructures and skepticism about health. Polio disability still has a profound social character and economic implications. Today, approximately 4-5 million people living in non-industrial regions suffer from polio and often do not have access to medical and rehabilitation programs for training, employment and social support. Among non-endemic countries, Ukraine has been rated by experts as a “high risk” for the spread of poliovirus, which determines the need to implement the Polio Eradication Initiative for 2019–2023 [3; 15].

The goals of the Polio Eradication Initiative for 2019–2023 are: I. Elimination (to stop the spread of all wild polioviruses, all outbreaks of circulating poliovirus of vaccine origin, to eliminate the risk of future emergence); II. Integration (promote strengthening of immunization and health systems, effective surveillance of poliovirus, prepare for, and respond to, outbreaks and emergencies); III. Certifications (to certify the elimination of wild poliovirus, to provide the content of all polioviruses) [3].

In a collaborative effort, a purposeful approach will be taken:

• in endemic countries – undertaking measures to prevent the distribution of wild poliovirus in major reservoirs;

• in countries where outbreaks are observed, the main priority will be to stop circulating vaccine-related variants of poliovirus outbreaks and to prevent future outbreaks in the future.;

• in non-endemic and unconfirmed outbreaks of countries with weak immunization systems, priority will be given to improving immunization coverage in the highest-level area to minimize the threat of outbreaks of circulating vaccine-related variants of poliovirus and to a longer-term objective to enhance systemic immunization and health protection [3; 5; 15].

In 2016, the world made the transition from the use of trivalent OPV (oral polio vaccine) to bivalent OPV. In the near future, the Initiative determines the withdrawal of bivalent OPV from planned use and the complete cessation of OPV use. The following vaccines are currently used in Ukraine to prevent polio:

• Monovalent oral polio vaccine type 1 and 3;

• Bivalent oral polio vaccine;

• Inactivated polio vaccine (IPV).

Vaccination in children is performed at 2 months, 4 months, 6 months, 18 months, 6 years and 14 years. IPV is applicable for I and II vaccinations, with contraindications to the introduction of IPV – for all vaccinations by age. IPV vaccine can be used for III-VI vaccinations both individually and in combination vaccines [2].

Oral polio vaccine is used for III-VI vaccinations, in the absence of contraindications to OPV. For children who are HIV-positive or with persons who are contraindicated in the introduction of IPV – in a family setting or in closed-type institutions, the vaccination is performed solely with the IPV vaccine. Vaccine-associated paralytic polio is characterized by the development of acute fatal paralytic polio cases, as a complication in children with immunodeficiency associated with the use of a live oral attenuated Sebine vaccine. The vaccine is a preparation of attenuated strains of polio virus type 1 – LSc2ab, type 2 – P712 Ch 2ab and type 3 – Leon 12a1b grown on primary kidney cells of African green monkeys or on primary culture of kidney cells in African green pastures Vero cell grafting cultures [8; 10].

The Sebins strains contained in the OPV originate from the DPV. The attenuation renders Sabin's strains genetically unstable, which determines their tendency to return to strains similar to wild poliovirus that are more viable. Some of these "reverberant" strains are called "vaccine-related polioviruses. The Polio Eradication Initiative reported 22 cases of vaccine-associated paralytic polio in 2017, 33 cases in 2018, and 24 cases in 2019 worldwide. This complication, according to various sources, is observed at a frequency of 1: 1.5-3 million primary vaccinated and persons who have had contact with them. The source of infection is a vaccinated one that releases the vaccine virus through the intestines for several weeks. According to WHO recommendations, vaccine-associated paralytic

polio can be attributed to the onset of which develops not earlier than 4 and not later than 30 days after vaccination, and for contact with vaccinated maximum period extends to 60 days; excretion of poliomyelitis virus, vaccine-related variants of poliovirus and not less than 4-fold increase in specific antibodies in the blood is recorded [3; 4; 12].

Unambiguous causes of vaccine-associated paralytic polio have not been established. It is generally accepted that the immunodeficiency state is a risk factor for its development in both the recipient and the contact of the child. Genetic instability of the vaccine strain plays a role in the pathogenesis [12].

The active substance IPV is the antigen of virions of wild strains of three immunological types of polio virus: 1 type of Mahoney, 2 type of MEF-1, 3 type of Saukett grown in the culture of Vero cells or diploid human cells. The nominal composition of the vaccine is represented by 40 units of type 1, 8 units of type 2 and 32 units of type 3 D-antigen. D-antigen is the antigen that determines the final concentrations of types 1, 2 and 3 viruses included in the trivalent IPV. IPV production technology is time consuming and requires strict monitoring of the inactivation completeness [2].

The recipient's immune responses to IPV and OPV vaccination are not the same. IPV causes the formation of specific antibodies that neutralize the virus in the blood and prevent the penetration of the virus into the motor neurons of the spinal cord and prevent their destruction. IPV is quite safe and effective, it is a specific component of multicomponent pediatric vaccines, including vaccines containing diphtheria, tetanus, whooping cough. It should be noted that inactivated vaccines have comparatively lower efficacy compared to live OPV. IPV vaccine does not protect the tissues of the gastrointestinal tract, does not cause local immunity in the intestine of the vaccinated and thus does not restrict the circulation of wild poliovirus in the population, because wild poliovirus can cause epidemics [13].

Live vaccine creates a longer and more effective protective immunity, stimulates the production of secretory IgA by the intestinal mucosa and limits the spread of wild virus, with the replacement of circulating wild poliovirus vaccine strains and natural spontaneous immunization of people in contact with those who circulate, introduction of IPV. The method of administration of the vaccine – oral, simple enough, does not require special conditions, equipment and apparatus. The vaccination process lasts for several weeks and leads to the formation of a sustainable life immunity [14].

OPV remains an effective tool for responding to polio outbreaks even after certification. The complete deletion of OPV is planned approximately one year after the certification of the liquidation of the wild poliovirus and will be based on the experience of transition from trivalent OPV to OPV. In the future, after the expected certification of global polio eradication in 2022, IPV will be the only vaccine used.

In all countries with significant population movements and contacts with poliomyelitis countries, surveillance for cases of acute paralysis should be strengthened in order to quickly detect any import of the virus and facilitate rapid response. In this context, high routine immunization is required to minimize the effects of virus reintroduction and an active immunization strategy – in case of outbreaks. Early detection and effective response to wild poliovirus is also a key factor in maintaining polio-free status. To this end, international organizations, governments and stakeholders need to pool global efforts to implement an effective strategy. In these circumstances, environmental surveillance of polioviruses plays a key role in monitoring the import of wild polioviruses and identifying new vaccine-related variants of polioviruses. Environmental monitoring includes the control of wastewater or other environmental samples for the verification of poliovirus. It is known that vaccine-related variants of polioviruses and wild poliovirus can remain in wastewater for two months, depending on environmental factors. The experience of many countries, including Finland, Egypt, India and Israel, has confirmed that environmental oversight can detect vaccine-related variants of polioviruses and wild polioviruses before the occurrence of acute paralysis [9; 14]. It should be noted that in the early stages of the disease, it is difficult to distinguish polio from other forms of acute paralysis. Therefore, to be sure that no case of polio will be detected, the observation is aimed at identifying symptoms of acute paralysis, not polio as a disease. Qualitative surveillance of acute paralysis is extremely important for countries nearing the final phase of polio eradication; All cases of this condition in children under 15 years of age and suspected cases of polio in people of any age should be reported. A complete clinical, epidemiological and virological examination should be performed in all cases of acute paralysis [11].

It should be noted about the tactics of quarantine measures: patients with polio must be isolated, discharged from the hospital not earlier than the 21st day after the disease. Due to the fact that the isolation of the virus from the intestine sometimes lasts up to 40-60 days, when transferring the patient to other medical institutions, it is necessary to give a virological examination. Persons who have been in contact with sick children and adults are subject to medical supervision for 20 days with daily thermometry. Children and adults who have been in contact with a patient with polio, if they have fever, catarrhal phenomena, intestinal disorders, are subject to isolation in an infectious hospital until the diagnosis is established. For children up to 7 years, as well as for medical indications and older children, unvaccinated or defectively vaccinated polio vaccine, at the earliest possible time after contact with a patient with poliomyelitis, enter "Human immunoglobulin normal" once in a dose of 3-6 mg [1].

Conclusions. In order to change the status of Ukraine as a non-endemic poliovirus high-risk country, the routine immunization and immunization of children under 10 years of age who have not received the necessary vaccinations by age should be kept high; to carry out appropriate epidemiological surveillance of polio, cases of acute paralysis and other enterovirus infections with enhanced virological monitoring of sewage.

References:

1. Ильченко В.И., Пикуль Е.В. Полиомиелит у детей. // Перинатология и педиатрия. – 2013. – № 3(55). – С. 112-117.
2. Карпова Е.В., Саркисян К.А., Мовсесянц А.А., Меркулов В.А. Вакцинопрофилактика полиомиелита на современном этапе. // БИОпрепараты. Профилактика, диагностика, лечение. – 2018. – № 4. Т.18. – С. 236-242.
3. Стратегия по завершению ликвидации полиомиелита на 2019-2023 гг. Ликвидация, интеграция, сертификация и контейнмент. http://polioeradication.org/wp-content/uploads/2019/06/russian-polio-endgame-strategy.pdf.
4. Amgad Abdel-Fattah, Abdel-Hady EL-Gilany, Ragaa El-Masry, Amr Kanddeel. Acute flaccid paralysis in North East Delta, Egypt: A retrospectiveanalysis of prospectively collected surveillance data. //Journal of Infection and Public Health. – 2019. – № 12. – P. 714–719.
5. Bahl Sunil, Bhatnagar Pankaj, Sutter W. Roland, Roesel Sigrun [at al.] Global Polio Eradication – Way Ahead. // Indian J Pediatr. – 2018. – 85(2). – P. 124–131. https://doi.org/10.1007/s12098-017-2586-8.
6. Brogårdh Christina, Lexell Jan, Sjödahl Hammarlund Catharina. Experiences of falls and strategies to manage the consequences of falls in persons with late effects of polio: a qualitative study. // J Rehabil Med. – 2017. № 49. – P.652–658. https://www.researchgate.net/publication/334490838_Post-polio_Syndrome_More_Than_Just_a_Lower_Motor_Neuron_Disease.
7. Icardi G., Tassinari F. Anti-polio vaccinations in the third millennia. // Ann Ig. – 2018. – № 30 (Suppl. 1). – P. 11-15. doi:10.7416/ai.2018.2228.
8. Jacob John T., Dhanya Dharmapalan. An ethical appraisal of the choice of vaccines against Poliomyelitis. // Indian Journal of Medical Ethics. – 2019. – Vol . IV, No 1. – P. 26-29.
9. Jacob John T., Dhanya Dharmapalan. The moral dilemma of the polio eradication programme. // Indian Journal of Medical Ethics. – 2019. – Vol. IV, No 4. – P. 294-297.
10. Kimberly M Thompson Polio endgame options: will we have the vaccines needed? Published: June 04, 2019 DOI: https://doi.org/10.1016/S0140-6736(19)31294-2.
11. Pikul K.V., Bobyreva L.E., Kushnereva T.V. [at al.] Rotavirus Infection in Children as of Today (Literature Review) // Wiadomo ci Lekarskie. – 2017. – T. LXX, nr 3, cz. II. – P. 622–628.
12. Stacey Li Hi Shing, Rangariroyas Post-polio Syndrome: More Than Just a Lower Motor Neuron Disease (5) // Frontiers in Neurology. – 2019. – Volume 10. Article 773.
13. Thandiwe Runyararo Mashunye, Duduzile Edith Ndwandwe, Kopano Rebaona Dube, Muki Shey [at al.] Protocol for a systematic review and meta-analysis of fractional dose compared with standard dose inactivated polio vaccination in children // BMJ Open.- 2019. – № 9. – P. 1-6. doi:10.1136/bmjopen-2018-023308.
14. Vallejo Celeste, Pearson Carl A.B., Koopman James, Hladish Thomas J. Evaluating the probability of silent circulation of polio insmall populations using the silent circulation statistic. //Infectious Disease Modelling. – 2019. № 4. – P. 239-250.
15. Zambon Maria, Martin Javier. Polio eradication: next steps and future challenges. https://www.researchgate.net/publication/329131665_Polio_eradication_next_steps_and_future_challenges.