

The Intervention and treatment of the Poliomyelitis

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Abstract. Polio comes from a wild polio-virus that infects children and has a high mortality rate. Once infected, there is no cure. So in the face of polio, more attention is paid to prevention measures and the follow-up treatment of survivors of polio disease. It covers the background to polio, the international response, and what has been achieved over the years in polio control. Polio prevention is divided into a vaccine component and daily protection, with the Inactivated polio vaccine (IPV) and Oral polio vaccine (OPV), OPV being an oral vaccine and IPV requiring a medical professional to administer it. The two are most effective when used together. Next is the daily protection, such as isolating close contacts and paying attention to human hygiene, etc. For the follow-up treatment of polio survivors that is, post-poliomyelitis patients. A variety of methods are used in this treatment, and the final clinical results show that non-pharmacologic treatment is more conducive to improving patients' lives and active treatment.

Keywords: Polio, Intervention, Treatment.

1. Introduction

Poliomyelitis (also be called polio) is a highly contagious disease, it is mainly caused by the polio virus which gives damages by invading the nervous system. In the worst situation, the polio virus can paralyze a person in a matter of hours, which makes it become a really dangerous virus that causes irreversible damage to the human body. Polio virus is transmitted through fecal-oral and person-to-person transmission, but at the same time, contaminated water or food also can become a vector, even if transmission rates are low. Children under five years old are the main transmission target of polio, and as long as the disease is incurable for the human body, the only effective way is to give the polio vaccine to prevent the virus [1]. Polio needs to be eradicated, and the assumption is that if any child gets polio, then every child in every region is at risk, and over ten years there could be at least 200,000 polio cases a year [1]. This will greatly increase child mortality worldwide, and even if they survive, they are more likely to develop post-polio syndrome later in life, which will also affect their lives and bodies.

Vaccination protects the human body against the polio virus. According to the WHO, since the start of the Global Polio Eradication Initiative (GPEI), which was established in 1988, cases of wild polio virus have fallen by 99%, from more than 300,000 cases in more than 125 countries to only 33 cases in 2018. Polio has been eradicated by vaccination in all but a few regions of the world, including Afghanistan and Pakistan. The polio vaccine has been instrumental in prevention. Vaccines are divided into IPV, which requires an injection, and OPV, which require oral administration and is easier to administer. It is also important to vaccine-based multiple interventions in areas where the polio virus is still present, such as source control, health system requirements for the environment, and protection of susceptible groups. Polio treatment is aimed at post-polio syndrome (PPS) among polio survivors. The main treatment for this problem is Non-pharmacologic treatment and pharmacologic treatment, the former has a more positive impact on patients than the latter. This article focuses on the intervention achieved based on the polio vaccination and the treatment of the PPS of polio survivors.

In general, how to prevent and treat the disease is very important. So our main focus is on polio prevention and treatment of polio survivors-the post-poliomyelitis patients. On the prevention side of

dealing with polio, what types of polio vaccine are available under vaccine-based prevention measures? What is the main action and adaptation of each vaccine to the virus? What is the difference between the effectiveness of the vaccine alone and the effectiveness of the vaccine in combination? And not just vaccine-based prevention, but prevention in everyday life, what daily precautions can be taken? What are their respective functions and methods? In the Post-polio myelitis syndrome term, there is a lot of focus on how to treat the post-polio myelitis syndrome. What is the treatment for this disease? Are there multiple treatment modes? Is the treatment more individual or post-polio myelitis? Which treatment is widely used and relatively effective?

This review focused on both the prevention and treatment of poliomyelitis and the treatment of post-polio myelitis, which is a very high risk for polio survivors, and the former will be described in detail.

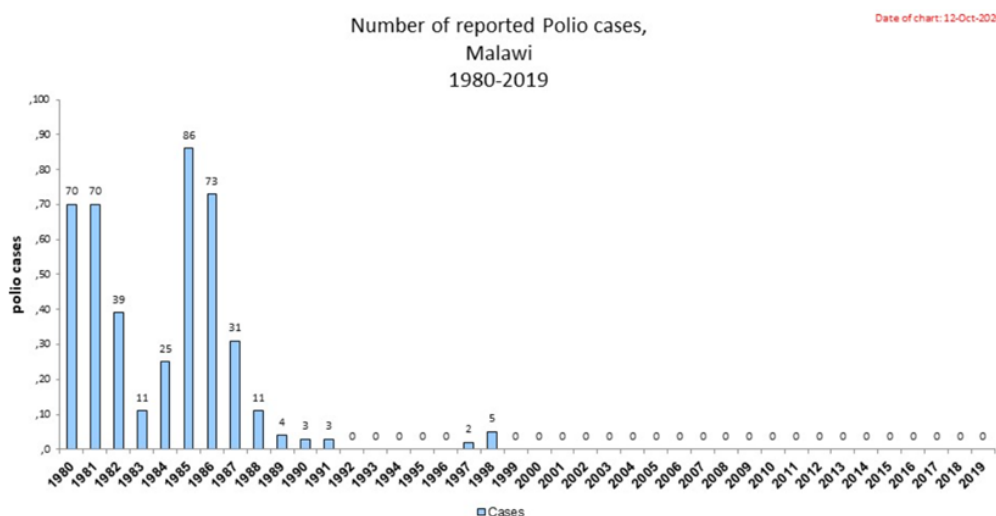


Figure 1. Reported Polio Cases.

2. Intervention for Poliomyelitis

2.1. Vaccines of Polio prevention

Poliomyelitis is an acute paralytic disease caused by three poliovirus (PV) serotypes. Less than 1% of PV infections result in acute flaccid paralysis [2]. There are ways to prevent people from getting polio, and these can be divided into two parts, one is vaccination and the other is daily attention. Let's start with "vaccination against polio". There are two types of vaccines in the world, one is the OPV and the other is the IPV.

2.2.1 OPV vaccine

The advantages of the OPV vaccine are , First of all OPV is done by "eating", which means it is very convenient and does not require the involvement of medical personnel. Don't look for it to require medical personnel, but it is very effective in preventing polio. Secondly it is effective in protecting the target serum and enhancing mucosal immunity. Finally, the attenuated poliovirus contained in OPV is able to replicate effectively in the intestine, but has about 10,000 times less ability to enter the central nervous system than wild virus. This allows individuals to develop an immune response to the virus. Almost all countries that have eradicated polio use OPV to block human-to-human transmission of the virus.4 OPV is also very inexpensive; in 2016, the United Nations priced OPV at \$0.12 to \$0.18 [3]. So OPV is an essential option for polio prevention.

The first vaccine to prevent polio was monovalent OPV (mOPV), which was developed in 1950 but has not been used since the introduction of tOPV, because monovalent OPVs produce immunity to only one of the three serotypes of polio, and they are more successful in conferring immunity to the target serotype compared to tOPV, but to the other two serotypes but did not provide protection against the other two, and so were replaced by tOPV.

Over time and as technology has evolved, researchers have found that the tOPV vaccine also has a fatal downside in that the live attenuated vaccine virus in tOPV causes paralysis, and although the probability of this is low - only 2-4 in a million births (there is a high probability of immunodeficiency at birth) - the World Health Organization announced in 2016 that tOPV was being discontinued because it causes many children to develop paralysis [4]. Although this may be an immunodeficiency, the condition is known as "vaccine-associated paralytic poliomyelitis (VAPP)," in addition to a more dreaded paralysis known as "circulating vaccine-derived poliovirus (cVDPV)" because it can be transmitted from a person to person and represents a cVDPV capable of infecting more people, both of which confirm that the WHO banned the use of tOPV and replaced it with bOPV, which is better for polio prevention.

A new oral polio vaccine type 2 (nOPV2) was developed to combat cVDPV, a modified version of the monovalent oral polio vaccine type 2 (mOPV2), which clinical trials have shown to provide considerable protection against poliovirus while being genetically more stable and less susceptible to cVDPV2 in low immunity settings. This means that nOPV2 has the potential to become an important tool to help stop outbreaks more permanently. However, this vaccine is still in the experimental phase and WHO is still conducting rigorous trials on it so that it can be used rapidly in the field [5].

2.1.2 IPV vaccine

There is also a vaccine called inactivated polio vaccine (IPV), which is a booster version called (eIPV), and in 2000, the United States switched to inactivated polio vaccine (IPV). IPV uses an inactive (dead) virus that does not cause polio. Because it contains killed poliovirus, it needs to be injected into the arm or leg by a trained health worker.

IPV is primarily for polio type 2, with intensive protection against polio types 1 and 3. IPV is very safe and does not cause strong side effects, only mild side effects such as redness and swelling. IPV can also be used in children with immune deficiencies or premature infants, but it is worth emphasizing that it is not recommended for children with severe allergies to the antibiotics neomycin, streptomycin, or polymyxin B or for those who are allergic to IPV Use.

The only disadvantages of IPV may be the harsher transport and storage environment and the need to use it together with OPV. IPV vaccine is shipped very strictly, cannot be frozen or heated, needs to be between 2 and 8 degrees and, most importantly, cannot be shaken.

2.1.3 Mixing IPV vaccine with OPV vaccine

Regarding vaccination, the World Health Organization recommends OPV and IPV together for best results. Some people have already been vaccinated with IPV, but they also need oral polio vaccine. IPV does not replace the benefits of OPV. Giving oral polio vaccine and oral polio vaccine at 3 1/2 months will ensure people are protected from polio. Both vaccines have their own advantages because people need a combination of IPV and OPV because OPV is given orally and provides protection in the mouth, intestines and blood. Oral and intestinal protection is important because poliovirus infects the mouth and multiplies in the intestine. IPV is an injectable vaccine that provides protection in the blood. IPV enhances the protection provided by OPV and helps improve people's overall protection against polio. Some people do not actively vaccinate and have not even had IPV or OPV until their child is a year and a half old. Any delay in vaccination puts your child at risk for contracting the diseases prevented by the vaccine. Following the recommended schedule will ensure maximum effectiveness of the vaccine. For children 3 1/2 months of age, one dose of IPV is optimized to ensure maximum protection against polio. If the schedule is missed, IPV should be given as soon as possible to ensure the child's safety. The correct and safe sequence of vaccine combinations is that the first two doses are OPV vaccine and the third dose is a combination of OPV and IPV vaccine (a combination that does not compromise the child's immune system), approximately two weeks apart.

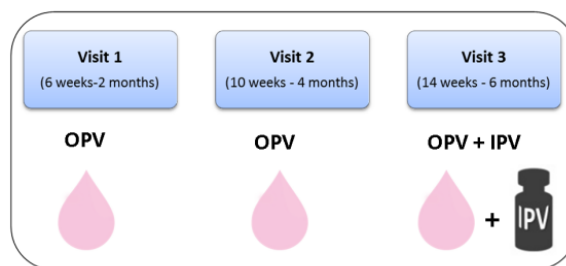


Figure 2. Vaccination planning table [7].

2.2. Daily prevention

In daily life, prevention of disease is always more difficult than quality disease, then first of all, we must understand what types of this disease are available, and how the infection, in order to better prevent polio polio can be divided into: recessive infection (asymptomatic type): accounting for 90-95% of all infected people, no symptoms appear after infection, the virus reproduction only stays in the digestive tract, does not produce viraemia, does not infiltrate the Central nervous system, but the virus can be isolated from the pharynx and feces Specific neutralizing antibodies can be detected in the body. The virus attacks the non-neural tissues of the body, and the clinical symptoms lack specificity and may include (1) inflammatory symptoms of the upper respiratory tract, such as fever, pharyngeal discomfort, pharyngeal congestion, lymphatic tissue hyperplasia in the posterior pharyngeal wall, and enlarged tonsils; (2) gastrointestinal symptoms, nausea, vomiting, diarrhea or constipation, and abdominal discomfort; (3) flu-like symptoms, joint and muscle pain, etc., which last for 1 to 3 days and recover on their own. ~The symptoms last for 1 to 3 days and recover on their own. Then there is the non-paralytic type: poliovirus invades the central nervous system and circulating nerve fibers spread throughout the body, so symptoms may appear at the beginning of the disease, but most patients may have no symptoms or reduced symptoms for 1 to 6 days after the prodromal phase, and then enter this phase. The last and most serious type of paralysis: it accounts for about 1 to 2% of infected patients and is characterized by the involvement of the gray matter of the anterior horn of the spinal cord, brain and cerebral nerve lesions on top of the clinical manifestations of the non-paralytic type, resulting in muscle paralysis. Daily prevention can be divided into four types, one is "automatic immunization" one is "passive immunization", one is "patient isolation", and the last is "good daily hygiene".

2.2.1 Automatic immunization

The first vaccine used was the inactivated polio vaccine (Salk vaccine), which was effective in protecting susceptible individuals after intramuscular injection and was safe for immunodeficient individuals because it did not contain live vaccine. In some countries, inactivated vaccine alone has also achieved remarkable results in controlling and almost eliminating polio. However, the short duration of immunity caused by inactivated vaccine, the need for repeated injections, and the lack of local immunity, and the high price of preparation are its shortcomings. However, in recent years, the preparation has been improved, and three vaccinations in the 2nd, 4th, and 12th to 18th months can produce 3 types of antibodies in 99% of the vaccinated patients and maintain them for at least 5 years. Live attenuated vaccine (Sabin vaccine, Oral polio-virus vaccine, OPV) is currently used more often. This live vaccine virus has been passed through tissue culture for many times and has no or very little toxicity to the human nervous system, and can multiply in the intestinal tissues of susceptible persons after oral administration, causing rapid growth of homo-neutralizing antibodies in the body. The immunity of the intestine and pharynx is also enhanced by the production of secretory IgA, which can eliminate the invading wild strains and cut off their spread in the population.

Three types of sugar pill vaccine have been made, which can be stored at 2-10°C for 5 months, 20°C for 10 days, and 30°C for 2 days only, so attention should still be paid to refrigeration (4-8°C). 2 months to 7 years old susceptible children are the main target of vaccination. However, children

and adults of other ages who are susceptible should also take the vaccine. Large-scale vaccination should be given in winter and spring, in 2 or 3 doses by mouth on an empty stomach, and not with hot boiled water, so as not to inactivate the virus in the vaccine and lose its effect. The sugar pill vaccine is divided into type 1 (red), type 2 (yellow), type 3 (green), mixed type 2 and 3 sugar pill vaccine (blue), and mixed type 1, 2 and 3 sugar pill vaccine (white). The latter has proven to be effective in immunization, with fewer doses and less likely to be missed, so China has gradually switched to a mixed vaccine of three types. Each oral dose must be given at least 4 to 6 weeks apart, preferably 2 months apart, to prevent possible mutual interference. To strengthen immunity, the vaccine can be repeated once a year for 2 to 3 years, and then again before entering school at age 7. Type-specific antibodies can be produced in the body about 2 weeks after oral vaccination, reaching a peak within 1 to 2 months and then gradually weakening, with half of the children having a significant decrease in antibodies after 3 years.

The oral vaccine rarely causes adverse reactions, with occasional mild fever and diarrhea. The vaccine is not recommended for those with active tuberculosis, severe rickets, chronic heart, liver and kidney disease, and acute fever. It has been reported that the neurovirulence of vaccine strains to monkeys may increase after repeated transmission through the human intestinal tract. In recent years, cases of paralysis have been found in countries where OPV is commonly used and confirmed to be caused by vaccine strains of virus, mostly in immunocompromised individuals. Therefore, it is currently believed that live attenuated vaccines are contraindicated in immunocompromised individuals, either in cases of congenital immunodeficiency or secondary immunocompromise due to medication, infection, or tumor. Contact with people taking OPV should also be avoided. Some people also advocate the use of inactivated vaccine followed by live attenuated vaccine for such patients, but most advocate the use of inactivated vaccine only.

2.2.2 Passive immunization

First, let's introduce what "passive immunization" is. Young children who have not been vaccinated, pregnant women, medical personnel, immunocompromised people, or after local surgery such as tonsillectomy, should be given gammaglobulin at a dose of 0.2 to 0.5 ml/kg or 6 to 9 ml of placental globulin once a day for 2 days if they are in close contact with the patient. [5] Immunity may be maintained for 3 to 6 weeks.

2.2.3 Patient isolation

Isolation should be for at least 40 days from the date of onset. In the first week, respiratory and intestinal isolation should be emphasized, excreta should be intercepted and disinfected with 20% bleach, eating utensils should be disinfected by soaking in 0.1% bleach clarifying solution or boiling, or exposed to sunlight for two days, the ground should be disinfected with lime water, the hands of contacts should be disinfected by soaking in 0.1% bleach clarifying solution or 0.1% peroxyacetic acid, and close contacts of susceptible persons should be isolated for observation

2.2.4 Good daily hygiene

It is important to improve environmental hygiene, eliminate flies and develop hygienic habits. During the outbreak, children should go to less crowded places, avoid overexertion and exposure to cold, and postpone various preventive injections and non-urgent surgeries, etc., to avoid prompting stroke-type infections to become paralysis.

3. Treatment for Post-Polio Syndrome

There is no treatment for polio outside of vaccine prevention, so post-polio syndrome is another problem for polio survivors. According to the CDC, the post-polio syndrome affects 25 to 40 of every 100 survivors, the incubation period can last 15 to 40 years, and can cause different health problems depending on the person who got the post-polio syndrome [2]. The main clinical symptoms of the post-polio syndrome are fatigue and cold tolerance; accompanied by human muscle problems (such

as muscle weakness and pain); joint pain and other related problems, also the increased requirements for metabolic capacity and the combination of expanded exercise units and different from the changes that occur in healthy people during aging will cause a burden on the body [4]. However, despite the many clinical symptoms of post-polio syndrome, the pathophysiology of the post-polio syndrome has not yet had a complete scientific status and explanation. So there are also some problems with the treatment of post-polio syndrome patients. For the treatment of post-polio syndrome, there are mainly two treatment methods, namely non-pharmacologic treatment and pharmacologic treatment.

4. Non-pharmacologic Treatment

The non-pharmacologic treatment is all based on a personal rehabilitation program, a series of physical changes to the patient to reduce or avoid the problem of secondary complications. In Gabriela's article, it was shown that through a series of physical therapy based on muscle training for patients with post-poliomyelitis syndrome, the patient's body was improved, and to some extent muscle, strength, and respiratory function were improved [8]. Muscle training and strengthening patients' muscles can effectively help them avoid or attenuate pathological features, but a complete plan is needed during the training process. So in Gabriela's study, a patient with post-poliomyelitis was given a specific training treatment to improve the patient's condition. At the same time, Gabriela take account the training intensity and other issues when designing the training plan. He added different steps such as interval training and rest between ordinary training to avoid the secondary injury caused by counterproductive overtraining patients [8].

At the same time, Farbu points out the importance of assistance in such training. Warm water has an analgesic effect, so it can be used as an aid during training. Moreover, warm water also has a positive effect on reducing muscle and joint pressure, so it will be a good aid during training [9]. Orthotics, walking supports, and ventilators are also important supporting tools. The former two are used to assist patients in walking, while the latter focuses on important tools for alleviating and avoiding respiratory complications [9].



Figure 3. Some Non-pharmacologic Treatment examples [11].

5. Pharmacologic Treatment

Pharmacologic treatment consists of the agents available and intravenous immunoglobulin. Because part of the pathology of post-polio syndrome patients is considered inflammation, there has been more of a shift in drug therapy toward how to treat inflammation. Therapists often consider using prednisone and amantadine together, pyridostigmine alone, or lamotrigine alone to address inflammatory problems but based on clinical and controlled studies, the use of these drugs has obvious advantages for post-polio syndrome patients [9].

Another method, intravenous immunoglobulin (IVIG) is used because it has long been known to have the potential to affect Fc receptors and activate B and T cells, so it is believed to be effective in patients with post-polio syndrome [9]. However, continuous use of IVIG is prone to meningitis, and although the impact is individual, IVIG can also bring some negative effects. For example, in one trial, researchers found that some patients experienced headaches and discomfort from IVIG injection, and the side effects lasted for a certain period [10]. According to Farbu, in a randomized controlled trial of multiple patients using this method, intravenous immunoglobulin showed significant changes

in pain and improvement in patients' quality of life but did not have positive effects on fatigue, muscle strength, and patients' physical performance [9]. Therefore, in some aspects, the side effects and cost of IVIG will have different kinds of burdens and negative impacts on the treatment.

6. Conclusion

Even though polio remains rare in most countries because of years of control and international interventions led by the WHO, it still needs to be taken seriously because only one case remains and polio could return. Within the range of intervention, there are two types of polio vaccines, IPV which is injected and OPV which is given orally. IPV needs to be given by a specialist, OPV does not, and OPV has different colors for different types of polio. There is no tOPV, but only bOPV because the side effects of tOPV (VAPP and cVDPV) are too severe. IPV is safe, but in short, if you want better prevention, you have to use OPV and IPV together to get better immunity. The next thing is about daily prevention, such as or see the patient and the patient's close contacts should be isolated, paying attention to daily hygiene is also very important. In terms of polio treatment, more attention has been paid to the post-polio syndrome of its survivors. Based on experiments and the use of various methods, it is found that there is not much room for improvement of drug therapy for patients, so for patients with post-polio syndrome, non-drug therapy is more likely to intervene in their body, and physical training plans are made according to the individual.

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