

Polio Virus

In this sheet we are going to study the polio virus, the virus that causes **Poliomyelitis**.

*The name of the disease came from two parts: 1- Polios: gray 2-Myelos: Spinal cord so it's the virus that affects the **gray matter of the spinal cord**.

*The scientists put the poliovirus on the list of the viruses that they hope to eradicate in the 21st century.

History

*The virus was first described in 1890, the viral etiology discovered in 1908. Then, in 1953, the inactivated polio vaccine (IPV) was discovered by Salk, and in 1961, the oral polio vaccine was discovered by Sabine. USA eradicates the virus in 1979 and the whole western world eradicates it in 1991.

Virology

*The poliovirus belongs to **Enterovirus group**. Small, ssRNA virus that have a capsid without an envelope, so it's highly resistant to the environmental factors.

*Serological classification : **3 serological types** (1,2,3), anyone who got infected by one of the types he will develop an immunity to it (the human is the only host) . Type 1 is the commonest.

*Circulating types:

1. **Wild type** (natural)

2. **Live attenuated OPV** -oral polio vaccine- (caused by vaccine)

3. **Virulent polioviruses derived from OPV** : the OPV is different from the wild type in only 1% of its genetic composition, so if a "low-immunity population" takes a OPV for years, it will develop a **mutation** at the end, becoming infectious virus with a very high virulence (higher than the wild type), causing a disorder called **Vaccine derived polio virus (VDPV)** .

Pathogenesis

*Firstly we should know that the transmission of the virus is **feco-orally**.

*After the entry of the virus it will be implanted in the mucosa, and replicated in the gut and lymphoid tissue associated with it, then it will reach the blood causing **minor viremia**, after that it will reach the reticuloendothelial tissues (liver, spleen, bone marrow), then we have two possibilities :

1- The immune system contains the virus and disease, with developing of life-long immunity against the virus.

2- The virus goes back to the blood causing **major viremia** with constitutional symptoms.

After the major viremia , we expect to have a CNS invasion , the virus reaches the nerve cell , then start moving from one neuron to another one , damaging the **motor and autonomic neurons but NOT the sensory ones** . the last stages (after 1-2 days) will be associated with destruction and **inflammation** that replaces the virus in neurons gradually.

*A large number of people get infected by poliovirus but less than 1% will have the disease.

*The places of the “central nervous system” that the virus tend to invade: 1- **Gray matter of anterior horn** 2-**Medulla and pons** (motor nuclei of certain cranial nerves)

Remember that : 1-the virus start to decrease in number after 1-2 days , and replaced by inflammation and fibrosis that persists for months .

2-the virus affect only the motor and autonomic neurons.

Clinical Features

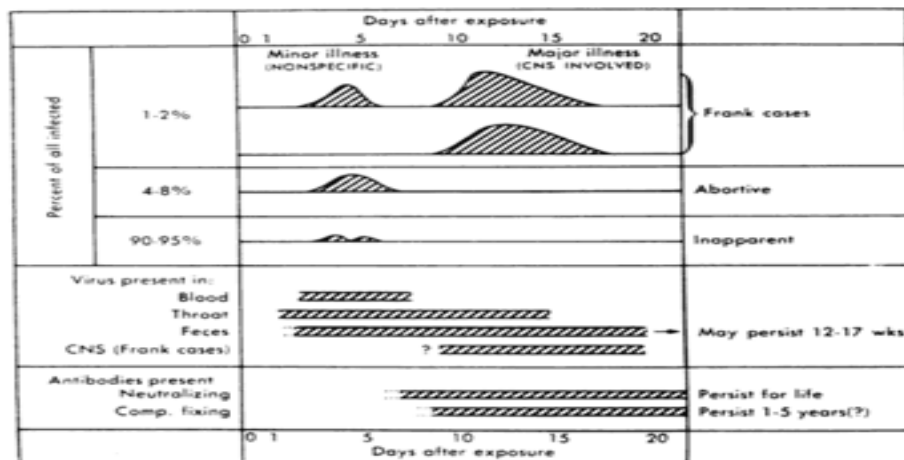
*Incubation period : **9-12 days** , then the symptoms start to appear , and the paralysis can be seen after 11-17 days after the beginning of symptoms.

* 95% of infected patients are **Asymptomatic**.

* Around 5% may have **Abortive poliomyelitis** : headache , fever , vomiting.

*some patients may have **meningeal irritation (non-paralytic polio)**.

*0.1% will develop **paralysis**.



We can notice from figure that the vast majority of the patients will have only minimal symptoms , also that some of paralytic patients will have minor illness before the paralysis. (we are talking about the upper half of the figure).

We will talk about the poliomyelitis as three types: 1.paralytic polio 2.bulbar polio 3.polio-encephalitis

Paralytic poliomyelitis : starts as myalgia (muscle pain) and localized paresthesia , followed by muscle spasm , after 1-2 days of these symptoms the paralysis begins and gradually increases , with a variation in severity from single muscle paralysis to quadriplegia .It is a **flaccid** (no muscle tone) **asymmetric** (hallmark for poliomyelitis) **paralysis**.

Proximal muscles involved more than the distal muscles, legs more than the arms.

- Proximal ms >> distal ms
- Legs>>arms
- One leg > one arm > both legs + both arms

*Very Rare sensory involvement.

Bulbar poliomyelitis : paralysis that affect the cranial nerves .

***5-30%** of paralytic patients will have bulbar poliomyelitis .

*Dysphagia , nasal speech , dyspnea , sometimes the fluids accumulates in the oral cavity causing difficulties in eating , hoarseness of voice .

Polio-encephalitis

*Very hard to be distinguished from other types of encephalitis (the presence of polio in the country can help us to diagnose it).

* Uncommon disorder, with higher incidence among **infants** , causes seizures.

Complications

1.**Respiratory compromise** : involvement of diaphragm and intercostals muscles.

2.**Airway obstruction** : involvement of cranial nerves (that supply the muscles of larynx).

3.**myocarditis**. (rare)

4.**GI** : hemorrhage , paralytic ileus , gastric dilatation. (Rare)

Risk factors

1. Paralysis More common in **boys** (but in general males and females are equally affected).

2.**pregnancy** : because of decrease in immunity .

3. **Heavy exercise** (during major illness) , the patient needs rest .

4. **IM injection** (area of injection may paralyze) but without knowing the exact reason .

5. **Tonsillectomy** : removing the tonsils will expose the nerve endings of certain cranial nerves that present behind the tonsils .

Differential diagnosis

*In relation to poliovirus , the differential diagnosis is important to distinguish the polio virus from :

1- **Enterovirus 71** (E71)

2- **West Nile Virus** (WNV)

3- **Guillain Barre syndrome** : it's an autoimmune disease (post-infectious) , it causes paralysis that must be distinguished from the paralytic polio in various ways (it's usually a question in the exams of Dr.Faris):

A. it involves the **sensory** neurons while the poliomyelitis doesn't .

B. **Symmetrical** paralysis.

C. **No fever** here while there is fever in polio.

D. **Paresthesia** (as a result of sensory involvement) .

E. In poliomyelitis , if we take a blood sample from the patient we will see High WBC count with normal amount of proteins (state called dissociation) , but in Guillain Barre syndrome we see **normal WBC count with high amount of protein**.

Diagnosis

1-We can take a sample of **CSF** and notice the presence of **aseptic meningitis** (raised amount of lymphocytes ,slightly raised protein levels , decreased sugar levels) .

Extra note said by the doctor : the septic meningitis associated with elevated neutrophils , high protein , and low sugar

2-We can culture the virus by taking a samples from the **throat** (at the early days) or **stool** (stays for months)

3-**Serology** : detecting antibodies usually for

*So if you see someone who have flaccid paralysis you should tell The Ministry Of Health in order to make sure that he is not infected by polio virus by taking samples from the patient at two different days, this called (Surveillance study).

*In Jordan there is flaccid paralysis but there is no polio virus.

Prognosis

*2/3 of patients will have permanent symptoms .

*Rare full recovery

*bulbar polio usually recover .

*If there is a Respiratory involvement then the recovery is rare , and they need mechanical ventilation .

*In old days , the mortality rate was (5%) but these days it must be less because of ventilators and physical therapy and other modern technologies.

Management

***No specific treatment** but you should advise the patient to have bed rest .

*Once the paralysis ceased we should start a **physical therapy**.

*Mechanical ventilation will be needed in the case of respiratory failure .

***Post Polio Syndrome** : affects some patients who recover from polio virus , after several years the patient will suffer from fatigue and weakness in the same limb that was paralyzed . It affects **20-30%** of paralytic patients and it is not severe disease.

One of the theories to explain this syndrome : If we suppose that the paralyzed muscle is controlled by 50 motor ganglion , and the polio destroys 30 ganglion , with the age and other factors there will be destroying for some of the remained 20 ganglion , so the muscle will lose some of its strength .

Vaccines

1-**Inactivated Polio Virus** (discovered by **Salk**)
(discovered by **Sabin**)

2-**Oral polio vaccine**

*Why the oral vaccine is better than the inactivated one ?

1-**Lower cost**

2-**More immunogenic**

3-**easier administration**

4-Herd immunity (community immunity), if 90% of certain population are vaccinated then the remained 10% will be protected , and if they carried the virus they will not transmit it to the vaccinated people.

The oral vaccine goes out with the stool so if anyone exposed to a vaccinated stool he will be vaccinated.

5-the vaccine resembles the original virus so it will develop a **GI immunity**.

*But the problem of the oral vaccine that it causes paralytic polio in **1 : 2.6million doses**.

*The **developing countries still use the oral type** because of its low cost and its efficiency , but the **developed countries return to the inactivated vaccine** because they eradicate the virus completely and the vaccine can reach the whole population , also to prevent the paralytic polio that caused by oral vaccine .

*In Jordan we use both types .

Eradication

*The eradication of the polio virus is one of the most successful issues in the history of medicine , nowadays the virus is found only in **Afghanistan , Nigeria and Pakistan** , unfortunately , they discovered 37 polio cases in Syria and 2 in Iraq , so the surrounded countries take the vaccine.

* The ratio of the patients with the disease to patient that are only carrier is **1 to 1000**.

Good Luck =)