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Research on AIDS Prevention and Treatment

Nahari Fukuga

Shanghai High School International Division, Shanghai, China

naharifukuga123@163.com

Abstract. Acquired Immune Deficiency Syndrome (AIDS) is caused by the Human Immunodeficiency Virus (HIV). This syndrome is a sexually transmitted disease that caused millions of lives lost in the last century. This disease was notorious for its incurability. This paper introduces and analyzes the prevention and treatment of AIDS. To conclude, there are four types of symptoms, namely the regular symptoms, respiratory symptoms, nervous system symptoms, and gastrointestinal symptoms. The treatments for AIDS include the antiviral therapy, nucleoside reverse transcriptase inhibitors (NRTIs), non-nucleoside reverse transcriptase inhibitors (NNRTIs), protease inhibitors (PIs), integrase inhibitors, fusion inhibitors, GP 120 attachment inhibitors, CCR5 antagonists, and post-attachment inhibitor or monoclonal antibody. The incurability of the syndrome still has to be solved since all of the treatments can only be used to prolong the patients' lives.

Keywords: AIDS, HIV, treatments, prevention, sexually transmitted disease

1. Introduction

AIDS is a syndrome representing the most distressing form of infection caused by the retrovirus HIV. In 1981, HIV was first diagnosed and the number of people infected globally was about 76 million [1], of which 22 million were dead and 13 million were left as orphans [1]. With the development of technology, the treatments developed were given with high hopes, however, none of them can thoroughly obliterate the virus. The treatments can only help prolong the patients' lives. At present, one of the advanced controlling methods for AIDS is the antiretroviral therapy (ART) [2], which is usually used with the combination of HIV medicine, but still cannot cure the infection thoroughly due to the incurability. Therefore, it is important for people to prevent from getting the disease in the first place. This paper first introduces the symptoms of HIV-infected patients. Then it summarizes the curing methods and prevention strategies for HIV. Hence, the paper can familiarize more people with HIV.

2. Symptoms of HIV

2.1. Regular Symptoms of HIV

Common symptoms may be called the primary or acute HIV infection, which usually occurs around 2-4 weeks after infecting the virus [3]. During these two weeks, patients usually do not recognize their own infection with the disease. In this case, getting a blood test is the best way of confirmation [4]. Signs and symptoms include mouth ulcers, red rash, aching muscles, etc. [5]. In this stage, HIV would multiply and spread rapidly throughout the body. The virus would attack and damage the immune

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system's CD4 T lymphocyte cells [6]. The HIV retrovirus would destroy a large number of CD4 cells and increase the HIV level in blood, thus increasing the chances of HIV transmission [7].

2.2. Respiratory Symptoms of HIV

Nose, sinuses, throat, and lungs can help people breathe, and these four body parts together form the respiratory system. If one is infected with HIV, one would be more prone to get infected with respiratory complications than ordinary people. Some of the respiratory symptoms include shortness of breath and coughing, phlegm, sinus infection, and sinus bronchitis [8]. In the human body, it has been discovered that T and B lymphocytes, pulmonary fibroblasts, macrophages, natural killer cells, eosinophils, monocytes, and dendritic cells are present in the lung, which is the major organ targeted by HIV infection. [9]. As the infection gradually infects the body organs, the depression of the CD4 lymphocytes and other immunological subsets occurs and would cause the patient to be more likely to be infected with infectious and non-infectious complications [9]. For patients diagnosed with HIV, the most common repiratory diagnoses are upper respiratory tract infection, acute sinusitis, and acute bronchitis. These respiratory diagnoses are common in the general population too. To prevent getting these diagnoses, the best way is to keep a healthy lifestyle, have decent hygiene, and be vaccinated [9]. The likelihood of HIV-infected people developing bacterial pneumonia is significantly higher than that of the general population. Nocardia, a slightly acid-fast, Gram-positive, branching higher bacterium, and Rhodococcus, a facultative intracellular pathogen, are the culprits behind this disease, which results in the formation of granulomas with or without caseating necrosis. [10].

2.3. Nervous System Symptoms of HIV

The central nervous system is also affected when HIV is infecting cells in the body. HIV and AIDS would cause several neurological complications, especially when one's HIV stepped into AIDS. The inflammation caused by HIV could damage the spinal cord and brain and restrain your nerve cells from functioning as usual. There are several reasons that the nervous system would be damaged, such as the virus itself, other effects of HIV and AIDS, and using past medicines. The health problems caused by HIV are dementia, viral infections, infections by fungi and parasites, nerve damage, vacuolar myelopathy, mental health problems, lymphomas, and neurosyphilis. HIV-associated dementia or AIDS dementia complex would affect the cognitive functions, for example, you would have trouble thinking, understanding, and recalling memories [11]. People who have HIV are more likely to contract viruses that harm the nerve system. The cytomegalovirus infection would impair your ability to think, as well as your ability to control your bladder and leg motions, as well as your eyesight, hearing, and breathing. It may also result in pneumonia. AIDS patients are more likely to get a herpes virus infection, such as shingles. Additionally, their risk of developing inflammation of the brain and spinal cord is higher. [11]. The viral infection may also cause Progressive multifocal leukoencephalopathy (PML), which is extremely aggressive and dangerous. PML would cause the cells that produce myelin to break down, which would cause the nerve cells to be vulnerable to facing the bacterium and viruses. PML would also cause brain damage, such as mental impairment, visual symptoms, and difficulty moving [12]. The infection caused by fungus is the Cryptococcal meningitis. It would cause the inflammation of the meninges, which protects the brain. Cryptococcal meningitis increases the pressure inside the skull and can destroy one or several parts of the brain [13]. The most common type of destruction caused by advanced HIV is nerve damage or neuropathy; it results in major pain or weakness, such as sores, numbness, tingling, and muscle weakness [14]. Weak and stiff legs and unsteadiness when walking are signs of the vacuolar myelopathy, which results in the myelin sheath pulling away from spinal cord nerve cells [15]. Patients with anxiety disorders and depression are more likely to experience mental health issues, and they are also more likely to experience hallucinations and major behavioral changes as HIV develops to AIDS. [16]. A cancer of the lymphatic system, which is a component of the body's defense against infection, is a lymphoma. The lymphatic system is made up of the thymus gland, bone marrow, lymph nodes, and spleen. The lymphoma could affect all of these parts [17]. Symptoms of lymphoma are swollen lymph nodes, fever, night sweats,

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feeling tired, and weight loss [18]. The lymphoma would gradually grow in or spread to the brain and is deadly [16]. Neurosyphilis is a disease of the covering of the brain, the brain itself, or the spinal cord. It would cause sores, like chancres [19]. A cancer of the lymphatic system, which is a component of the body's defense against infection, is a lymphoma. The lymphatic system is made up of the thymus gland, bone marrow, lymph nodes, and spleen. [16]. Possible symptoms include partial paralysis or weakness, emotional lability, difficulty with memory, psychosis, personality changes, changes in sensation in the limbs, loss of coordination, and progressive dementia [20]. Last but not least, the nervous system side effects of HIV progression include forgetfulness or confusion, a weak feeling that may worsen over time, changes in behavior, headaches, balance and coordination problems, seizures, changes in vision, difficulty swallowing, abrupt swings in heart rate and blood pressure, diarrhea or loss of bladder control, and mental health problems. [16].

2.4. Gastrointestinal Symptoms of HIV

Gastrointestinal issues have been among the most prevalent AIDS symptoms since the pandemic's inception. Before combining antiretroviral medication, it was hypothesized that between 50 and 93 percent of HIV patients reported experiencing gastrointestinal problems while unwell. [21]. Meanwhile, gastrointestinal diseases are one of the major causes of high mortality and morbidity rate of late AIDS [22]. Anorexia, weight loss, nausea, vomiting, dysphagia (odynophagia), stomach discomfort, anorectal illness, GI hemorrhage, jaundice, hepatomegaly, and gastrointestinal tumors are some of the debilitating symptoms of gastrointestinal conditions. [23]. Among these symptoms, weight loss, is a major contributor to death in most patients with AIDS. The host metabolic response to the infection is starvation, and patients would be likely to be given additional calories [24]. When working with patients who have dysphagia (difficulty swallowing with a feeling that food is sticking), it's important to determine if their symptoms are oropharyngeal or oesophageal in nature. When swallowing, patients with oropharyngeal dysphagia frequently report feeling as though the food gets stuck in their throats. They may also experience coughing, choking, and nasal regurgitation while swallowing. Patients with oesophageal dysphagia frequently describe feeling as though food is trapped in the throat after swallowing [25]. Chronic diarrhea is one of the most common complications among people with HIV infection. For people who have HIV, chronic diarrhea would impede the absorption of antiretroviral drugs, contributing to suboptimal viral control and the premature development of drug resistance. Diarrhea could further cause dehydration and the depletion of nutrients absorbed from foods and electrolytes, such as potassium and sodium. Consequently, excessive fluid loss would threaten one's life when they have a severely compromised immune system [26]. HIV mainly affects one's gastrointestinal tract by damaging mucosal cells that comprise the gut-associated lymphoid tissue, which is an early site for HIV replication and depletion of CD4 cells. The chronic inflammation associated with long-term infection would also damage the mucosal function of the intestines, leading to inflammatory-bowel disease [26]. The central nervous system disease that affects eating mechanics or the perception of hunger, malabsorption, or medications are some of the body mechanisms that are affected by the anorexia, which is a common problem in HIV infection. These body mechanisms further contribute to weight loss and starvation. [27]. Different from other symptoms, nausea, and vomiting are mainly caused by the HIV treatment medications, the highly active antiretroviral therapy (HAART). The urge to vomit is known as nausea, which can have psychological or medical causes such as issues with the brain or upper digestive system organs. [28]. HIV Patients with abdominal pain are mainly caused by the destruction of the immune system of the body; as the body weakens, our body is easily prone to a wide variety of infections and diseases. The infections in the gastrointestinal would become acute, causing sudden pain around the abdomen [29]. Anorectal disease is common among HIV-infected patients since HIV is associated with a wide spectrum of anorectal diseases. Some symptoms are anal pain, tenesmus, urgency, purulent drainage, and bleeding [30]. HIV is linked to gastrointestinal malignancies, the two most common of which are Kaposi's sarcoma and non-Hodgkin lymphoma. The most prevalent occurrence of Kaposi's sarcoma is in the advanced stages of AIDS; it may result in gastrointestinal bleeding or malabsorption. At any stage of HIV infection,

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non-lymphoma Hodgkin's can manifest as stomach pain, weight loss, diarrhea, intestinal blockage, and swollen lymph nodes. [31].

3. Cure for HIV

Currently, HIV and AIDS are still incurable. Your body can not get rid of the illness once you have it. Nevertheless, there are numerous treatments and drugs that are successful in battling HIV and associated complications, and are probably capable of controlling and preventing problems. The antiretroviral therapy is the most effective HIV treatment (ART). To reduce the number of virus in the body, this is the combination of two or more drugs from several therapeutic classes. It would lengthen the patient's life and slow the virus's pace of growth. If the meds are properly administered, most people can control the infection within six months. More than two dozen antiretroviral medications to treat HIV have received FDA approval. They are divided into six categories.

3.1. Nucleoside Reverse Transcriptase Inhibitors (NRTIs)

By inhibiting HIV's reverse transcriptase, NRTIs prevent the virus from tranforming its RNA into DNA. It caused the HIV virus to use outdated building blocks, preventing infected cells from producing new HIV. [32]. Thus, managing to prevent HIV from replicating. Examples of NRTIs are Abacavir, Didanosine, Emtricitabine, Lamivudine, Stavudine, Tenofovir alafenamide, Tenofovir disoproxil fumarate, and Zidovudine.

3.2. Non-Nucleoside Reverse Transcriptase Inhibitors (NNRTIs)

NNRTIs function by preventing reverse transcriptase from successfully converting the viral single-stranded RNA genome into DNA, hence preventing HIV-1 replication [33]. They cause an allosteric inhibition of the transcriptase by binding directly to the enzyme at a location other than the nucleoside binding component. NNRTIs include cabotegravir, Delavirdine, Doravirine, Efavirenz, Etravirine, Nevrapine, and Rilpivirine as approved medications.

3.3. Protease Inhibitors (PIs)

Protease inhibitors are proteins that could bind to the proteolytic enzymes, then block the ability of this enzyme to function. The result of blocking this enzyme is that it could prevent HIV from reproducing itself since the protease inhibitors could lower the body's HIV viral load and slow the progression of HIV [34].

3.4. Integrase Inhibitors (INSTIs)

By inhibiting the enzyme integrase, NSTIs stops HIV from putting its genetic code into the DNA of the infected cell [35]. The HIV life cycle is disrupted if this enzyme isn't present because HIV cannot take over CD4 cells to replicate [36]. Bictegravir, Cabotegravir with rilpivirine, Cabotegravir, Dolutegravir, Elvitegravir, and Raltegravir are a few of the medications that have been approved.

3.5. Fusion Inhibitors

The fusion inhibitor would bind to the gp41 protein on the outside of the virus. The gp41 is associated with the physical merging of the protein coat of the virus and CD4 cells, allowing HIV to get inside the host cell [37]. By blocking the gp41, the fusion process is inhibited, meaning HIV could not fuse with the healthy cells, thus unable to replicate itself. An example of an approved drug is the Enfuvirtide [38].

3.6. GP120 Attachment Inhibitor

There is only one medicine in this brand-new class, fostemsavir. It is for persons with HIV who are no longer responding to other treatments. By attacking the virus' surface glycoprotein 120, this medication prevents the virus from adhering to CD4 T cells in the body's immune system.

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3.7. CCR5 Antagonist

CCR5 acts differently as the fusion inhibitor; it blocks a specific "hook" on the outside of certain cells so that the virus would not be able to bind with it. Primarily blocking the CCR5 coreceptor on the surface of CD4 T-cells, thus preventing HIV from replicating itself [39]. The only approved medication is the maraviroc.

3.8. Post-Attachment Inhibitor or Monoclonal Antibody

A brand-new class of antiviral drugs called post-attachment inhibitors is made just for individuals whose HIV has developed resistance to conventional therapies. Ibalizumab-uiyk, a licensed medication, would prevent HIV-positive cells in the body from infecting uninfected cells with the virus.

4. Prevention of HIV

Despite the fact that HIV can be prevented, there were more than 1.6 million new cases of the disease in the world in 2019, with 150,000 of those cases involving children. The greatest method to lower the rate of new infections is to specifically understand the HIV prevention strategy. HIV can be passed from one person to another through sex, sharing a contaminated needle, mother-to-child transmission during pregnancy or breastfeeding, and contaminated blood transfusions. Correct use of the male latex condom during sexual activity lowers the risk of HIV transmission and sexually transmitted diseases. Maintaining the mother on antiretroviral therapy from before conception to the end of breastfeeding would prevent mother-to-child transmission by reducing the viral load and curing HIV.

5. Conclusion

In conclusion, previous research has shown that the AIDS is caused by the HIV which transmits primarily during the period of sex. This virus attacks the body's immune system by disabling white blood cells and other immune cells. not noticing own body got infected with HIV, then further damages would be made. The symptoms of infecting HIV are divided into four types, regular symptoms, respiratory symptoms, nervous system symptoms, and gastrointestinal symptoms. In the early stages of HIV, the main symptoms are Mouth ulcers, red rash, aching muscles, joint pains, unintentional weight loss, fever, loss of coordination, tiredness, headache, swollen lymph nodes, sore throat, diarrhea, seven flu-like symptoms, vomiting, nausea, lack of appetite, and dry cough. This disease will contaminate other parts of the body, and different signs will appear depending on the part of the body. With the different stages of development among the patients, the doctors would provide the suitable treatment combinations to the patients, the possible treatments include NRTIs, NNRTIs, INSTLs, fusion inhibitors, GP120 attachment inhibitor, CCR5 antagonist, or post-attachment inhibitor/ monoclonal antibody. The above treatments can only have the effect of prolonging the patients' lives. Therefore, the best way to solve the disease is preventing from getting the disease. People should only have sexual relationships with someone HIV-free, letting the hospitals would use a new needle, and make sure the mother is HIV-free during pregnancy or breastfeeding. As the gradual development for different kinds of treatments targeting HIV, none of the treatments can cure it. If someone accidentally got infected, then the chance of entirely purging the virus is impossible. Although the modern technology could not cure AIDS, we believe in the later future, with the rapid development of technology, treatments that are capable of curing AIDS would be invented, just like other diseases being cured in the past several years.

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