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"ANTI- HIV USING NANOROBOTS"

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ABSTRACT

HIV therapy could benefit greatly from the use of nanorobots since they could allow for more precise and efficient drug delivery as well as gene editing. Although there are currently no approved systems for treating HIV with nanorobots, a number of encouraging experiments have been carried out to show that this strategy is feasible. By delivering medications straight to HIV-positive cells, nanorobots can be trained to identify particular surface indicators. This lowers the patient's body's viral load and slows the disease's progression. Furthermore, gene editing instruments that nanorobots can carry may be utilized to eradicate the virus from affected cells. Nevertheless, more investigation is required to improve these systems and assess their performance and safety in animal models and clinical

Keywords: HIV, WBC, nanorobots, nanotechnology, and CD4 protein.

I. INTRODUCTION

1.1 Nanorobots- These days, robotics technology is used in many fields. Nanorobotics is one of its subcategories. Teams of biotech and robotics specialists are working together to develop complex, tiny robots in this field of robotics. The components' microscopic structure makes it possible to simulate human behavior. Building the many intricate components that comprise a robot is now feasible thanks to nano-robotics. In the 1980s and 1990s, a few authors began to speculate on the potential physical forms that future medical nanorobots might take. A few created artistic depictions of their gadgets. Up till now, only the broadest studies of the possible missions and capabilities have been conducted. Pioneer of the field of nanorobot technology Adriano Cavalcanti developed a concept for the useful hardware based on nano bioelectronics.

1.2 HIV- The virus known as HIV is the source of the AIDS epidemic in Figure 1. The body's special defense system against all diseases and germs is rendered ineffective in an AIDS patient. HIV stands for human immunodeficiency virus. Like all viruses, HIV cannot grow or reproduce by itself. To proliferate, it has to infect a living organism's cells. Beyond human cells, HIV exists as roughly spherical particles. There are countless tiny spikes all over the surface of each particle. An HIV particle can have a diameter of 100–150 billionths of a meter. It is comparable to 0.1 microns in general. Unlike other viruses, HIV particles are far too tiny to be seen under a normal microscope.

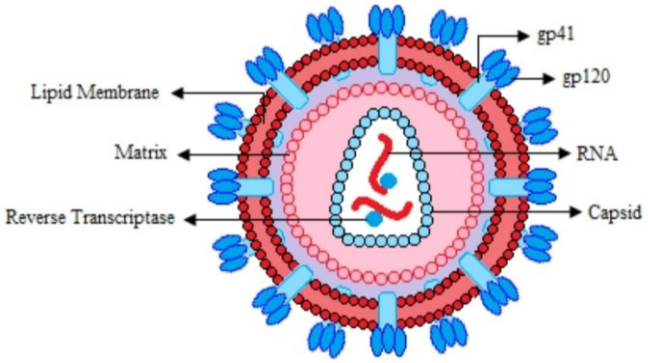

Fig 1 : Structure of HIV Virus

1.3 Spreading of AIDS- By itself, AIDS is not a deadly disease. AIDS is brought on by the HIV virus, which has the capacity to compromise immunity. Because of this, the host system is vulnerable to mild illnesses that have the potential to be lethal but are not yet. The HIV virus targets the WBCs and transforms them into HIV. Every WBC is thus converted to HIV, which weakens the immune system. The patient passed away as a result of this.

1.4 Latest Drugs against HIV- Zidovudine, the most current drug used to treat AIDS, binds to the HIV genome before reverse transcriptase can function, making DNA synthesis impossible. However, the efficacy of this medicine can disappear at any time.

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II. METHODOLOGY

2.1 Nanorobots Performing Operation on Blood Cells

Viral genomes can be destroyed by nanorobots. This kind of nanorobot consists of a data converter, a container with highly concentrated DNase and DNase enzymes, and a nano biosensor made by experts in nanoelectronics. Through the use of a nanorobot to restore the original form of AIDS-affected WBCs, the patient's immune system is kept in constant state. The nanorobot reverses the HIV process.

2.2 Reason for Using Nanorobots

Most animal cells are between 10,000 and 20,000 nanometers in diameter. Nanoscale devices may now enter cells and their enclosing organelles to interact with proteins and DNA. Numerous diagnostic tests can be carried out simultaneously and with greater sensitivity thanks to nanotechnology. The advancement of nanotechnology could make it possible to identify illness in a very small number of cells or tissues. All things considered, nanotechnology might offer us a faster and more efficient approach to finish a lot of the jobs we do now

2.3 Components of the Nanorobots

Payload-This vacant space is used to contain a little amount of medication or another substance. As the nanorobots travel through the blood to the site of the damage or illness, the medication may be released.

Micro camera- The nanorobot might have a tiny camera built into it. The nanorobot can be manually controlled by the operator as it moves through the body. The electrode on the nanorobot may function as a battery by using the electrolytes in the blood.

Electrodes- These projecting electrodes might similarly destroy the injured cells by generating an electric current and heating them to death.

Swimming tail- Nanorobots require a form of propulsion in order to penetrate the body because they travel against the blood flow of the body.

2.4 Onboard computers of Nanorobot

Power System- The glucose molecules found in human bodies provide energy for nanorobots.

Nano Logic Processor- By addressing the primary sensing, actuation, data transmission, uploading of remote controls, and linking power supply subsystem, it covers the essentials of controlling medical equipment.

Sensors- Molecular recognition sites, optical, magnetic, and electromagnetic sensors, as well as position and orientation sensors, will all be included in the nanorobot arsenal. Additionally, DNA sensors will be incorporated into the nanorobots.

DNA Sensor- The DNA sensor is a cantilever type. One arm is used for the real sample, while the other is used for the WBC sample. Even if there is just one base variation between the samples, it can still be determined.

Antenna Interface- A system for tracking an item in space includes a transponder device that is affixed to the object. Through one or more transponder antennas on the transponder device, an RF signal is received by a transponder circuit.

RNA Converter- It alters the RNA of the HIV virus.

Actuators-It's a device that opens and closes valves and pumps fluids at the nanoscale. It is mostly used in this approach to provide translational mobility to the nanorobot.

2.5 Approaches

There are two approaches used to create nanorobots.

- Top Down Approach
- Bottom Up Approach

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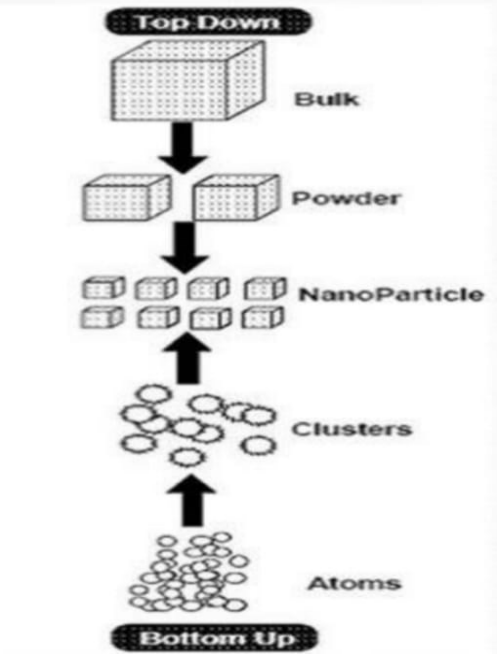

Fig 2: Different approaches for building of nanorobot

The most popular way for creating anti-HIV nanorobots is shown in Fig. 2, which is the bottom-up approach. It involves assembling structures, atom by atom or molecule by molecule, that will be useful in the production of the gadgets.

2.6 Introduce the Device into the Body

Without causing excessive collateral damage, the nanorobots must be inserted into the body and allowed access to the operation site. Though there are a few things to consider, we have already opted to enter through the circulatory system. Nanorobots should measure the tiniest blood vessel they can fit through before determining their size. The blood vessel's walls shouldn't be damaged, and it shouldn't be excessively blocked, as this could thwart attempts to avoid the condition we're seeking to cure in the first place by either reducing or stopping blood flow of possibly causing a clot to form. This suggests that a smaller Nano-machine is obviously superior. This must be evaluated in light of the reality that a bigger

2.7 PROCESS

The biosensor's task in Fig. 3 is to identify a certain material. In this case, the biosensor will include a particular antibody. The HIV envelope proteins gp41 and gp120 are two different proteins found in the cell membrane of an infected cell. The antigen and antibody reaction will produce the right signal. This reaction will only happen in the case of infected cells since certain viral proteins are only found in the cell membrane of infected cells. The DNase and RNase enzymes will be released by the nanorobot when it inserts its nanotube into the infected cell's nucleus following receipt of the positive signal. The DNase enzyme will split signal nucleotides since the viral genome is present across the complete genomic DNA.

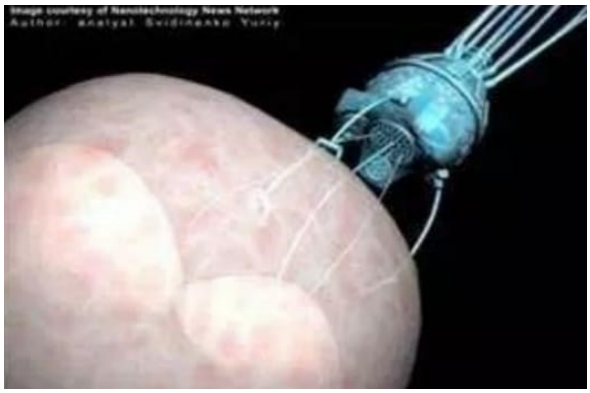

Fig 3: Blood cell manipulation via a nanorobot

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2.8 Challenges faced by Nanorobots

When developing nanoscale nanorobots, a deeper understanding of the interactions between materials on this small scale should be gained. Matter behaves differently at the nanoscale than it does at larger sizes. In order to prevent injury to humans from nanorobots, both within and outside the body, it is crucial to monitor their behavior.

2.9 Structure

Two slots in the structure of the nanorobot will be :

Interior: It will be a vacuum-sealed environment in which outside substances won't frequently be able to enter.

Exterior: Our bodies will be subjected to a variety of chemical solutions.

2.10 Requirements of the Nanorobot

- It must be minuscule in order to avoid obstructing the passage of blood capillaries.
- It shouldn't be impacted by the WBC.
- It must be limited to identifying and acting upon WBC that are HIV positive.
- It ought to immediately return the tainted WBC to its original state.
- To make it easier for the patient to afford, it ought to be constructed of less expensive materials.

III. SYSTEM ANALYSIS

3.1 Existing System

There isn't yet a system for treating HIV with nanorobots that has been given the green light for clinical use. Nanorobots, however, might be promising approach for the treatment of HIV, according to some encouraging investigations and experiments. A 2018 study that appeared in the journal Nature Communications described the creation of a nanorobot that could recognize and eliminate HIV-positive cells in vitro. A gold nanorod coated with a peptide that blinds to the CD4 receptor on the surface of HIV- infected cells served as the basis for the nanorobot. Near-infrared light was utilized to activate the nanorobot once it had adhered to the diseased cell, which heated up the gold nanorod and killed the cell.

3.2 Proposed System

A system that uses nanorobots to treat HIV may combine targeted medicine delivery with gene editing. The system would be made up of nanorobots whose sole purpose would be to find and destroy HIV-positive cells while preserving healthy ones. The nanorobots may be designed to recognize certain indicators on the surface of HIV-positive cells, such as the HIV envelope protein or the CD4 receptor. Once the nanorobot has attached to the infected cell, it may release a payload of drugs that are toxic to the virus or the infected cells themselves. This would help to slow the disease's course and lower the patient's body viral load.

IV. ADVANTAGES

- Millions of people are afflicted by this horrifying disease globally. At the moment, there isn't.
- The disease has a lifelong vaccine or therapy. Nowadays, available drugs can.
- By developing this nanorobot, the patients' lives will be cut short, allowing them to recuperate from their conditions.
- Producing in batches reduces development costs, even if they are large initially.

V. CONCLUSION

The study only offers a theoretical justification. However, recent advancements in nanotechnology increase the likelihood of successful application in the medical field. Future developments in the Nano era could include the use of nanotechnology in the treatment of AIDS. In conclusion, there have been encouraging developments in the usage of nanorobots in the HIV epidemic. Drugs can be delivered to infected cells directly by nanorobots, improving therapy efficacy and minimizing side effects. Additionally, the utilization of nanorobots can aid in overcoming the drawbacks of the antiretroviral therapy that is currently available, including inadequate medication distribution and drug resistance. All things considered, the field of using nanorobots in HIV treatment is fast developing and has enormous potential to improve the lives of millions of afflicted individuals.

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