First Indigenous mRNA Vaccine Technology

Why in News?

Council of Scientific & Industrial Research- Centre for Cellular & Molecular Biology (CSIR-CCMB) has announced the success of **'proof of principle'** of the first indigenous Messenger RNA (mRNA) vaccine technology.

- This is different from the mRNA vaccine being developed by Gennova Bio based on self-replicating RNA.
- According to the researcher, the technology is ready to be transferred to any interested company to take it to the next step of performing human trials and bringing the vaccine to market with regulatory approval.

Proof of Principle

- Proof of Principle, also called Proof of concept, is a realization of a certain method or idea in order to demonstrate its feasibility, or a demonstration in principle with the aim of verifying that some concept or theory has practical potential.

What is mRNA Vaccine Technology?

- **About:**
  - mRNA vaccines use mRNA to teach our cells how to make a protein or a protein that triggers an immune response inside our bodies. That immune response, which produces antibodies, is what protects us from getting infected if the real virus enters our bodies.
  - The researchers developed indigenous potential mRNA vaccine candidate against **SARS-CoV-2.**
  - It is based on the **Moderna model**, but has been built with the information available in the open and indigenous technology and materials.
- **Efficacy:**
  - “Robust immune response” has been observed against the Covid-19 **spike protein** in mice upon administration of two doses of the mRNA.
  - The anti-spike antibodies generated were found to be more than 90% efficient in preventing the human ACE2 receptor binding to the coronavirus
    - Angiotensin converting enzyme 2 (ACE-2), known as ACEH (ACE homolog), is an integral membrane protein.
    - ACE-2 serves as the receptor for the SARS-CoV and SARS-CoV-2 viruses.
    - It provides the entry point for the coronavirus to hook into and infect a wide range of human cells.
- **Significance:**
  - The indigenous grown mRNA vaccine platform holds promise to deal with other infectious diseases such as **Tuberculosis**, Dengue fever, Malaria, Chickungunya, Rare Genetic diseases and others.
    - The vaccines can be used for covering a pan-Covid-19 vaccine with different variants.
    - With that, vaccines can be developed for other diseases.

What are Different Types of vaccines?

- **Indigenously Developed Vaccines:**
    - **ZyCoV-D**: Designed and developed by Zydus (a pharmaceutical company) with support from the DBT.
    - **Covaxin:** Developed by Bharat Biotech in collaboration with the ICMR.
- **Globally Developed Vaccines:**
    - **Covishield:** Name given to an Oxford-AstraZeneca Covid-19 vaccine candidate which is technically referred to as AZD1222 or ChAdOx 1 nCoV-19.
    - **Sputnik V:** The first vaccine to be officially registered and has been developed by Moscow's Gamaleya Institute in collaboration with Russia's defence ministry.

How are mRNA Vaccines Different From Traditional Vaccines?

- Vaccines work by training the body to recognise and respond to the proteins produced by disease-causing organisms, such as a virus or bacteria.
- Traditional vaccines are made up of small or inactivated doses of the whole disease-causing organism, or the proteins that it produces, which are introduced into the body to provoke the immune system into mounting a response.
- mRNA vaccines tricks the body into producing some of the viral proteins itself.
    - They work by using mRNA, or messenger RNA, which is the molecule that essentially puts DNA instructions into action. Inside a cell, mRNA is used as a template to build a protein.

What are the Advantages of Using mRNA Based Vaccines?

- mRNA vaccines are considered safe as mRNA is non-infectious, non-integrating in nature, and degraded by standard cellular mechanisms.
- They are highly efficacious because of their inherent capability of being translatable into the protein structure inside the cell cytoplasm.
- Additionally, mRNA vaccines are fully synthetic and do not require a host for growth, e.g., eggs or bacteria. Therefore, they can be quickly manufactured inexpensively to ensure their "availability" and "accessibility" for mass vaccination on a sustainable basis.

UPSC Civil Services Examination, Previous Year's Question (PYQs)

Q. Widespread resistance of malarial parasite to drugs like chloroquine has prompted attempts to develop a malarial vaccine to combat malaria. Why is it difficult to develop an effective malaria vaccine? (2010)

(a) Malaria is caused by several species of Plasmodium
(b) Man does not develop immunity to malaria during natural infection
(c) Vaccines can be developed only against bacteria
(d) Man is only an intermediate host and not the definitive host

Ans: (b)

Exp:

- Malaria is a life-threatening disease caused by Plasmodium parasites that are transmitted to people through infected female Anopheles mosquitoes.
- The malarial parasite has an extraordinary ability to evade the immune system, which explains the difficulty in developing an effective malaria vaccine.
- RTS,S/AS01 (RTS,S) is the first and, to date, the only vaccine to show partial protection against malaria in young children.
- **Hence, option (b) is correct**.

Q. With reference to recent developments regarding 'Recombinant Vector Vaccines', consider the following statements:

1. Genetic engineering is applied in the development of these vaccines.
2. Bacteria and viruses are used as vectors.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

Ans: (c)

Exp:

- Recombinant vector vaccines are made through genetic engineering. The gene that creates the protein for a bacteria or virus is isolated and placed inside another cell's genes. When that cell reproduces, it produces vaccine proteins that mean the immune system will recognize the protein and protect the body against it. **Hence, statement 1 is correct.**
- Live recombinant bacteria or viral vectors effectively stimulate the immune system as in natural infections and have intrinsic adjuvant properties. They are used as the channel for the entry into the host organism.
- Several bacteria have been used as vectors, such as Mycobacterium bovis BCG, Listeria monocytogenes, Salmonella spp. and Shigella spp.
- Numerous viral vectors are available for vaccine development, such as vaccinia, modified vaccinia virus Ankara, adenovirus, adeno-associated virus, retrovirus/lentivirus, alphavirus, herpes virus, etc. **Hence, statement 2 is correct.**

Source: TH