mRNA Vaccine

In the wake of the Wuhan Coronavirus (Covid-19), scientists have poured money and manpower to come up with an effective vaccine to combat the virus.

The mRNA (messenger RNA) is one such vaccine which injects pieces of mRNA into human cells in order to get them the produce pathogen antigens.

This article will give further details about the mRNA Vaccine within the context of the IAS Exam

Overview of mRNA Vaccine

The first known demonstration of RNA vaccines was by scientists at Karolinska Institute in 1994. The earliest known attempts to use mRNA against disease is attributed to Hungarian biochemist Katalin Kariko. He tested it on mice which showed positive results.

In 2005, Harvard stem cell biologist Derrick Rossi read Kariko's paper and founded the biotech Moderna with Robert Langer, who saw its potential in vaccine development.

Another mRNA biotech, BioNTech, was founded in Germany and licensed Kariko's work. By November 2020, no mRNA drug had yet been licensed for use in humans, however, both Moderna and BioNTech were close to emergency use authorization for their mRNA-based COVID-19 vaccine

How does the mRNA vaccine work?

The mRNA vaccines function differently from traditional vaccines. Traditional vaccines stimulate an antibody response by injecting a human with antigens. mRNA vaccines inject a fragment of the RNA sequence of a virus directly into the cells, which then stimulate an adaptive immune response.mRNA fragment is a specific piece of the virus that carries instructions to build the antigen of the virus. An advantage of RNA vaccines is that they stimulate cellular immunity.

Unlike DNA vaccines, mRNA vaccines are more fragile as the molecules degrade within minutes when exposed to the outside environment, hence they need to be stored in extremely low temperature.

Advantages and Risks of the mRNA Vaccine

Like any new vaccine technology mRNA vaccines have their fairs share of specific and general risks they are as follows:

- Some mRNA-based vaccine platforms induce potent interferon type I responses, which have been associated not only with inflammation but also potentially with autoimmunity.

  Thus, the identification of individuals at an increased risk of autoimmune reactions before mRNA vaccination may allow reasonable precautions to be taken.

- The risks associated with mRNA strands that did not manage to pass into a human cell are considered to be low, as the fragile mRNA molecule should be quickly broken down inside the body once its drug delivery system has eroded.

- mRNA vaccines are new, and before 2020, no mRNA technology platform had ever been authorized for human use, and thus there is the risk of unknown effects, both short and longer-term.

- mRNA is very fragile, and thus the vaccine has to be kept at very low temperatures to avoid degrading and thus giving little real immunity to the recipient; the BioNtech/Pfizer COVID-19 vaccine has to be kept at -70 degrees Celsius for example which may put developing nations with tropical weather conditions at a disadvantage.

Advantages

- As RNA vaccines are not constructed from an active pathogen (or even an inactivated pathogen), they are non-infectious. In contrast, traditional vaccines require the production of pathogens, which, if done at high volumes, could increase the risks of localized outbreaks of the virus at the production facility.

- RNA vaccines can be produced faster, cheaper, and in a more standardized fashion (i.e. fewer error rates in production), which improves responsiveness to outbreaks.

- An additional ORF coding for a replication mechanism can be added to amplify antigen translation and therefore immune response, decreasing the amount of starting material needed.