Capsule Summary

m-RNA Vaccines for COVID-19, a short review

COVID-19, also known as Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) caused a global pandemic starting in late 2019. COVID-19 has affected more than 200 million people worldwide leading to greater than 4 million deaths, and this severe respiratory disease continues to threaten public health and safety on a massive scale. In the absence of definitive therapeutics to treat COVID-19, vaccines represent the major preventative strategy to protect human lives. Vaccines have helped us defeat numerous life-threatening infectious diseases, and the emerging novel vaccines for COVID-19 represent our best hope to not only protect human lives but also lessen the impact on limited public health resources worldwide. Vaccines train our immune cells to generate protective antibodies against invading pathogens, thereby strengthening out body's defense system against infectious diseases.

One of the earliest breakthroughs in COVID-19 vaccines came with the development of novel messenger RNA (mRNA) based vaccines, which showcases a paradigm shift in the vaccine field. mRNA vaccines are designed to encode a specific structural component of the invading pathogen [1-3]. Upon injection of the mRNA vaccine, our immune cells use that genetic code to generate pathogen specific proteins. These newly generated proteins are recognized by our immune cells as foreign antigens, leading to a robust immune response and production of protective antibodies. Importantly, the injected mRNA has a short lifespan within human tissues and is effectively destroyed by our cells without any adverse consequences on our genetic makeup [3, 4]. Generation of protective antibodies helps defend our bodies against subsequent exposure to the actual infection causing pathogen.

The COVID-19 mRNA vaccine encodes the genetic code for its spike protein, which helps viral attachment to our cells aiding its intracellular entry [3]. mRNA vaccines utilizes a lipid-nanoparticle based delivery system which shield the mRNA from degradation and allows for efficient delivery of the mRNA inside our immune cells [3]. mRNA based COVID-19 vaccines approved for human use via the emergency use authorization are currently exclusively being manufactured by the two major pharmaceutical companies including Pfizer-BioNTech (BNT162b2) and Moderna (mRNA-1273).

The current full vaccination schedule for these vaccines dictate two doses administered at least 21 days apart. Vaccination with two doses of Pfizer-BioNTech and Moderna vaccine provides an overall effectiveness of approximately 95.3% and 94.1% respectively against COVID-19 illness including severe disease [5, 6]. However, the need for cold-chain storage for these mRNA vaccines introduces logistical difficulties in handling, especially for developing countries. From a safety standpoint, mRNA vaccines are relatively safe, with low incidence of minor to moderate adverse events observed in clinical trials. Anaphylactic reactions have been documented at rates of 4.7 cases per million doses of Pfizer-BioNTech vaccine and 2.5 cases per million of Moderna vaccine [7]. However, scientists believe and attribute these allergic response to the pre-existing antibodies against the PEGylated lipids used in delivery formulation of the mRNA vaccines [3].

Nonetheless, scientists are to be commended for developing these mRNA based vaccines against COVID-19 in such a short time span, which is not less than a miracle. The significant protection offered by these vaccines against preventing severe COVD-19 illness has had a tremendous impact on our everyday lives. With the emergence of increasingly transmissible variants of COVID-19, the mRNA-based vaccines could be adapted to deliver the genetic codes against specific viral variants. mRNA-based vaccine platform provides an excellent mechanism for developing novel vaccines against COVID-19 and will continue to play a pivotal role in our fight against life-threatening infectious diseases.

Information Source:

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