

Synthetic mRNA vaccines: the Past, the Present and the Future

Pascolo Steve

University Hospital of Zurich, Zurich, Switzerland
steve.pascolo@usz.ch

Messenger RNA (mRNA) is a transient copy of a gene. Produced in the nucleus from chromosomal DNA, it is translated into proteins in the cytosole and then degraded. In its natural form mRNA is the active ingredient in old vaccines such as anti- Yellow Fever, -Mumps, -Measles or Rubella vaccines. In its synthetic form mRNA is used for the development of experimental vaccines since early 90s and got approved in 2020 as the first anti-COVID19 vaccine. Production of synthetic mRNA in vitro is fast and robust. Formulated in a lipid nanoparticles and injected intramuscularly, the synthetic mRNA coding for the SARS-CoV-2 spike protein is safe and provides great protection against COVID-19. Besides its utilisation in vaccines (several mRNA vaccines have been approved and many are being now tested in clinical studies), synthetic mRNA can be designed and formulated so that it does not induce inflammation and therefore can be used for therapies (i.e. expression of therapeutic proteins). Thus, future synthetic mRNA formulations will allow the prevention and treatment of a large range of diseases. This paper will present:

- The four formats of synthetic mRNA: in vitro transcribed linear, circular, and (trans) replicating or chemically synthesized
- Manufacturing challenges and solutions for each mRNA format
- Optimisation of formulation and administration site according to clinical objectives (vaccines or therapies)