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Press release

COVID-19: Vaccine Research at Inserm

The mobilization of Inserm researchers has led to major advances in SARS-CoV-2 knowledge and vaccine research. © Inserm/Depardieu, Michel

Developing an effective and safe vaccine is one of the priority objectives in the fight to contain the COVID-19 pandemic. Since the complete sequencing of the SARS-CoV-2 genome in January 2020, research teams in France and internationally have been working tirelessly to better understand the immune response following infection and to test candidate vaccines. At Inserm, a dozen teams are involved in vaccine research projects. In particular, three initiatives have recently been selected by France's Ministry of Higher Education, Research and Innovation on the advice of the COVID-19 Analysis, Research and Expertise Committee (CARE) and Inserm's REACTing consortium, in order to receive special support and thus accelerate research.

Currently, more than 200 teams around the world are engaged in research projects to develop a vaccine against COVID-19. These include some thirty French groups that are members of the AVIESAN alliance or the biotech/industry ecosystem. Researchers from Inserm are also not to be outdone, since a dozen of these projects involve its units.

While the degree of progress of this research varies, some of these teams are currently in the phase of identifying the antigenic sequences of the virus that induce the specific immune response against SARS-CoV-2 and minimize the possible production of facilitator antibodies (a type of antibody that facilitates the entry of the virus into cells). In addition, some of the proposed vaccine platforms have been used previously for other candidate vaccines, including against HIV, influenza and toxoplasma, or for oncology vaccines.

The various ongoing projects can be divided into three main categories. The first is that of subunit vaccines, which do not contain live components but rather antigenic fragments of the pathogen. The second is a group of live attenuated candidate vaccines, all of which are prophylactic. The third is vaccines based on DNA or RNA coding for SARS-CoV-2 antigens.

Innovative candidate vaccines

Within this dynamic ecosystem, three projects involving Inserm units have been identified as priorities by the Ministry of Higher Education, Research and Innovation.

The first is driven by the Vaccine Research Institute (VRI), under the supervision of Inserm. The team led by Pr. Yves Lévy is involved in French COVID-19, the national cohort of patients infected with SARS-CoV-2, coordinated by Inserm's REACTing network, in conjunction with 56 hospitals in France. Initially, using data from these patients, the researchers' objective was to characterize the immune response in COVID-19 positive patients. Indeed, this data is essential and a prerequisite for the development of any vaccine. Based on this work, but also on their expertise in vaccine research, they are now developing a candidate vaccine in which the SARS-CoV-2 antigens would be presented by monoclonal antibodies to certain key cells of the immune system (dendritic cells). VRI has already developed several candidate vaccines based on this strategy, including against HIV (for which clinical trials will start in 2020).

The second vaccine research project, carried out at the Lille Center for Infection and Immunity by Inserm researcher Camille Locht and his team, is based on the repurposing of vectors with known activity, by integrating SARS-CoV-2 antigenic sequences. In this particular case, the chosen vector is a whooping cough vaccine. The objective is to develop a safe candidate vaccine, whose action on the body is well documented and very specific to the novel coronavirus because it incorporates carefully selected antigens.

Led by Inserm researcher Patrice Marche at the Institute for Advanced Biosciences and researcher Fabrice Navarro, head of CEA-Leti's Microfluidic Systems and Bioengineering Laboratory, the third project also proposes an original vaccine approach against SARS- CoV- 2. It is based on an innovative delivery system involving lipid nanoparticles developed by the researchers. These highly stable and well-tolerated nanoparticles were originally created to encapsulate and transport drugs to target cells. In the fight against SARS- CoV-2, the researchers hope to encapsulate antigens of the virus to elicit a strong immune response.

Having already used this technique in HIV vaccine research, the team should quickly be able to develop this new candidate vaccine on a large scale, which represents a major advantage in making research faster and more efficient.

Developing a safe and effective vaccine against COVID-19 is a long process. Nevertheless, the mobilization of the scientific community, and in particular Inserm researchers, is enabling major advances to be made in terms of understanding the virus and the immune response to it, and in terms of setting up numerous trials to test a wide variety of vaccine strategies in record time.

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