DESCRIPTION FOR THE GENERAL PUBLIC

For centuries, infectious diseases have had devastating effect on human populations, often leading to the falls of empires. The first vaccine was made against smallpox by Edward Jenner in 18th century; it opened a completely new field in protection measures against human and animal pathogens. Today many vaccines are administered to children and adults protecting whole populations against dangerous, or even deadly, diseases. Vaccines confer protection against bacterial, viral or sometimes even against parasitic diseases. In case of bacterial infections, apart from vaccines, antibiotics are powerful therapeutic agents; for viral infections the number of antiviral drugs is relatively low, and vaccines remain the main factor of protection. Therefore, the development of new vaccines or improvement of already existing antiviral vaccines is of paramount importance. Historically two types of vaccines were used against viral diseases – killed virus vaccines or attenuated viral strains. With the advent of recombinant era technologies, a number of other approaches came into light, namely vaccines based on recombinant viral proteins, viral DNAs or viral RNAs. Out of recombinant protein vaccines, the only ones that found application in human therapy are so called virus-like particles. They can be defined as empty shells of viruses resembling authentic viruses but devoid of genetic material, so the virus cannot multiply. However, virus-like particles retain many properties of viruses – they can enter cells using the same receptors as viruses and they provoke very strong immunological response of both types important for conferring protection: humoral and cellular response. At present, RNA vaccines are also regarded as the most promising new type of vaccines. In contrast to DNA, RNA is not integrated into cell genomic material, so mutations resulting from the administration of these vaccines are not possible. Moreover, they are highly potent, and the cost of production is relatively low. The main drawbacks of RNA vaccines are the difficulties in the delivery to the interior of cells and their instability when they enter cells; these factors hinder their long-time effect. Dr. Jacek Jemielity of the University of Warsaw, the partner in this application, is a coauthor of many publications and patents describing methods to increase the stability of RNA. We, at the Department of Recombinant Vaccines at the University of Gdansk, specialize in the construction of virus-like particles for many viruses with pathogenic potential. We plan to combine our expertise in order to construct vaccines on the basis of viral-like particles and mRNA which would retain the advantages of both vaccination agents and at the same time would reduce their weak points. mRNAs coding for viral antigens stabilized by chemical modifications will be sequestrated by viral-like particles and the resulting tandem will be selectively delivered to the inside of target cells thanks to the cell receptors for viral-like particles. We anticipate that such superstructures will cause augmentation of immunological response directed both against viral-like particles as well as against proteins encoded by introduced mRNA. Our prospective aim is to produce novel recombinant vaccines against two devastating diseases: influenza and tick-borne encephalitis. Seasonal influenza affects each year over 10% of world population, while the incidence of tick-borne encephalitis has increased over 400% during the past 20 years in Europe. The existing vaccines against these diseases are far from being perfect. Influenza vaccinations have to be repeated every year and the effectiveness of protection rarely exceeds 50%; tick-borne encephalitis vaccine can cause adverse reactions, especially in children. Our project application addresses the needs for vaccine improvements in these respects. We plan to obtain effective universal vaccine against influenza with long-lasting protection and anti-tick-borne encephalitis vaccine with no side effects.