The Universal Flu Vaccine

Ever since Edward Jenner developed the first vaccine in 1796 against smallpox, vaccines have become a critical part of healthcare and public health (1). Vaccines have allowed healthcare professionals to control or nearly eradicate many different viral diseases. A notable exception is the influenza or flu virus, which has continued to pose a challenge for vaccine development and maintains high numbers of reported infections each year. The CDC estimated that there were over 32 million flu cases from October 1, 2019 through February 22, 2020 (2). After extensive research, scientists are now closer to developing a universal flu vaccine, with at least one in its testing phases (3). This vaccine could also potentially provide a method to prevent other viral infections, such as those that cause the common cold.

Understanding the science behind vaccines is valuable in comprehending the challenges of developing a universal flu vaccine. The two most common types of vaccines are live vaccines and inactivated vaccines (4). In “live”, or attenuated, vaccines the virus of a particular disease is weakened enough to not cause the illness associated with the particular virus. Inactive vaccines contain an inactivated or “dead” version of the virus (4). Although described as containing “living” or “dead” versions of a virus, it is important to understand that viruses are not considered living, and must take control of the machinery in a living cell in order to replicate. Once these forms of the viral vaccine are administered, the immune system in healthy individuals recognizes that they are foreign, and initiates an immune response. This is diagrammed in Figure A (5).

The immune response is complex and contains many stages and components. One of the first stages, or lines of defense, is the innate immune system. The innate immune system is on constant watch for invading germs, which are recognized as foreign to the body. If a virus evades this first line of defense, then the adaptive immune system is necessary to control the spread of the germ. This line of defense by the immune system has two versions that will respond: the “humoral” that will produce antibodies to inactivate the virus and the “cellular” that produces cytotoxic “killer” T-lymphocytes that kill virally infected cells. This adaptive response typically takes a week to 10 days to be fully triggered and, within a few weeks, it
will clear the infection. At the end of this few weeks, it leaves both the humoral and cellular systems with memory cells to more rapidly fend off future infections. These immune memory cells can persist in the blood and tissues for many years. If the infectious virus is ever re-introduced into the body, the memory cells will mount an effective immune response in a few days, instead of the typical seven to ten days that it would take to react to a novel infection.

Unfortunately, viruses such as the flu are constantly mutating and evading recognition by memory cells. This means that a year after a single vaccination or contracting the flu, the original immunity may not be as effective because the virus has mutated (6). These mutated versions are often referred to as the different “strains” of the virus. While flu vaccines typically protect against two to four different strains, new strains are constantly evolving to which the body might not be immune. Scientists have methods that allow them to anticipate and predict which flu strains will be prominent each season. This is why a new flu vaccine is needed annually. Flu vaccines have been designed against parts of the virus that are easily recognized by the human immune system. Unfortunately, it is these regions of the flu virus that often mutate.

An effective universal flu vaccine would protect people from many more strains of the flu than the yearly flu vaccine. As seen in Figure B, the ideal universal flu vaccine would be at least 75% effective in protecting against symptomatic flu infections, would protect against the two different groups of type A flu viruses, give more than a year’s immunity, and work in all age groups (7).

The National Institutes of Health is now beginning the first human trial of a universal flu vaccine. The vaccine, which is called H1ssF_3928, “is designed to teach the body to make protective immune responses against diverse influenza subtypes by focusing the immune system on a portion of the virus that varies relatively little from strain to strain” (8). This would prevent future mutated strains from evading the immune system. Hemagglutinin (HA) is a protein on the outside of the flu virus that allows flu viruses that have entered a person’s body to attach to and penetrate into cells of the upper respiratory tract, nose, and eyes. This protein consists of a head and stalk section as seen in Figure C (9). Typical vaccines use the head of this protein to
initiate an immune response in the body. Unfortunately, the head of the HA protein can mutate and change enough among new strains of the virus that it can evade the adaptive immune system memory (7). Understanding what is and is not typically recognized by the immune system was the key to the prospective universal vaccine. Scientists now are using the deeper stalk of the HA protein in developing a new, hopefully universal, vaccine since this area of the HA protein rarely mutates (8).

With many people concerned about infectious diseases because of the Covid-19 pandemic, there is increased awareness of the dangers of viruses, and their ability to spread. The development of the universal flu vaccine could greatly reduce the death toll caused by the flu virus. According to the CDC, in under six months, there were over 18,000 deaths from the flu in the US (2). The concept of utilizing proteins on the virus that are constant among strains could also be applied to the development of vaccines for the common cold. Because the testing of this vaccine is not far enough along, any potential risks or drawbacks are unknown. It is currently unclear whether the flu virus has or will develop strains for which the universal vaccine will not work. For now, this vaccine has the potential to greatly reduce the harm and impact of the flu and protect a greater population from illness.

Works Cited:


