

Recent Development of Inactivated Vaccine – A Review

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Abstract: *Vaccinations have always proven to be the most cost-effective strategy for controlling a wide variety of infectious diseases in humans and animals. In the last several decades, veterinary vaccines have been substantially developed and demonstrated their effectiveness against many diseases. Vaccine is a biological fluid prepared from a killed or weakened bacteria or viruses, with the chief purpose to stimulate antibody production.*

Keywords: Live vaccine, Killed vaccine, Industry animal, Vector vaccine, Development.

1. Introduction

An inactivated vaccine consists of virus particles, bacteria, or other pathogens that have been grown in culture and then killed using a method such as boiling or treatment with formaldehyde. In contrast, live vaccines (which are attenuated vaccines) use pathogens that are still alive (but are attenuated, that is, weakened). Pathogens for inactivated vaccines are grown under controlled conditions and are killed as a means to reduce infectivity, thus prevent infection from the vaccine. Killed or inactivated influenza vaccines, which were first developed in the 1940s from viruses grown in embryonated chicken eggs, have evolved to highly purified, standardized vaccines that are produced annually in millions of doses and are updated annually to contain currently circulating strains of influenza A and B.

Influenza is significant cause of morbidity and mortality and has a major social and economic impact throughout the world. During major catastrophe many people require medical treatment or hospitalization.

As we know, mortality often accompanies influenza epidemics, the vast majority affected being the elderly. Since it constitutes the most rapidly increasing sector of the populations of many countries, the epidemiology of influenza can be expected to change accordingly, especially in the developed countries.

The only solution to the problem of influenza prophylaxis generally available at present is vaccination.

2. Public Health Strategies

Inactivated viruses tend to produce a weaker response by the immune system than living viruses, immunologic adjuvants and multiple "booster" injections may be required to provide an effective immune response against the inactivated pathogen. Attenuated vaccines are often preferable for healthy people because a single dose is often safe and very effective.

Unfortunately, some people cannot take attenuated vaccines because the pathogen poses too much risk for them (for

example, elderly people or people with immunodeficiency). For such patients, an inactivated vaccine can provide protection.

Among various public health strategies in place to combat influenza, vaccination is the most cost-effective strategy against annual seasonal influenza. Inactivated "killed" influenza vaccines are in use since the 1940s with improvements primarily made in production technologies and use of adjuvants.

As an alternative, live attenuated influenza vaccine, has been in use in Russia for over 50 years and in 2003 was licensed for use in North America. Just recently, Europe has licensed this vaccine and recommended its use in children from 2–18 years of age. However, this new live attenuated influenza vaccine (LAIV) has been in development since the 1970s and extensive data on safety and efficacy is available, immunological mechanisms of action and correlates of protection remain unclear. When we review our current understanding of the efficacy of LAIV in humans, compare trivalent inactivated influenza vaccine (TIV) to LAIV and highlight the key research questions that will impact immunization policies with LAIV.

3. Epidemiology of Influenza

There are three types of influenza virus (A, B and C). The A type is the most common type found in a wide variety of birds and mammals, while types B and C are predominantly human pathogens. Influenza A virus is subdivided into different subtypes based on antigenic differences in the surface glycoproteins, hemagglutinin (HA) and neuraminidase (NA). All the seasonal influenza epidemics are caused by subtypes of Influenza A and Influenza B viruses while Influenza A viruses are responsible for influenza pandemics.

Influenza is a negative sense segmented RNA virus with two surface glycoproteins and nine internal proteins. The surface glycoproteins, HA and NA permit attachment of the virus from infected cells. In fact, HA trimer protein has a globular head region with sialic acid receptor binding sites enabling the attachment to host cells. The mutations in receptor-

binding sites on globular head are responsible for the antigenic variation that generates drift variant virus strains responsible for seasonal outbreaks of influenza. In the unpredictable intervals, different subtypes of influenza A virus undergo gene re-assortments to give rise to a novel virus strain that is capable of causing pandemics in the immunologically naïve population. When a pandemic virus emerges, it replaces previously circulating Influenza A strain of same subtype, as seen with the 2009 H1N1pdm09 virus. In fact, avian influenza viruses, e.g., H5N1 or H7N9 can cause human infection following close contact with infected poultry but to date remain non-transmissible between humans.

4. Effect of Influenza on Children

Healthy children aged 2 years have hospitalization rates of up to 12 times during influenza periods and hospitalization rates of older children comparable to rates in the elderly population. In the year 2003, killed influenza vaccines were “recommended” for children with high-risk conditions and were “encouraged” for children aged 6–23 months.

Study of several thousand children show that split-virus vaccines are safe and immunogenic in healthy children aged 6 months and in high-risk children. In the children of age group of 9 years, 2 doses of vaccine are required initially to achieve maximum protection. The studies of children aged 6 months to 15 years show vaccine efficacies of 31%–91% against influenza A and 45% against influenza B. Among the children attending day care, a reduction in the rate of acute otitis media of 32%–36% was demonstrated.

Studies suggested that the use of killed vaccines among children is cost-saving. Studies have proved that killed influenza vaccines in children are safer, immunogenic, effective, and potentially cost-saving.

Influenza is a major illness in the elderly population and for persons with underlying chronic conditions, kills up to 37,000 persons annually. Epidemiological data show that influenza causes high rates of hospitalization among children.

Killed-virus influenza vaccines, that had been licensed for use in children aged 6 months for many decades, are largely unused for infants and children. As of now, there is an effort to expand the use of influenza vaccines among children.

At the 15–16 October Advisory Committee for Immunization Practices (ACIP) voted to “recommend” routine annual use of influenza vaccine for the children of age group 6–23 months for the season beginning in the fall of 2004. This review focuses on the literature on the use of killed-virus influenza vaccines in children.

5. Conclusions

There is always great demand of new vaccines to effectively control newly and re-emerging pathogens in livestock.

Development of veterinary vaccines is becoming a challenging task, due to a variety of pathogens, hosts, and the

uniqueness of host-susceptibility to each pathogen. Therefore, novel concepts of vaccines should be explored to overcome limitation of conventional vaccines.

There has been great advancement in the completion of genomic sequencing of pathogens, the application of comparative genomic and transcriptome analysis. It would facilitate to open opportunities up to investigate a new generation of vaccines; recombinant subunit vaccine, virus-like particle, DNA vaccine, and vector-vehicle vaccine. Such types of vaccines are being actively tested against various livestock diseases, affording numerous advantages over conventional vaccines, including ease of production, immunogenicity, safety, and multivalence in a single shot.

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