Gene Vaccines Offer a Precise and Powerful Approach to Treating Serious Infections

What is the problem and what is known about it so far?
Traditional vaccines use a dead or modified organism—usually a virus—or part of the pathogen to stimulate the immune system to produce antibodies. These antibodies lie in wait to combat the disease agent if it invades the body. Vaccines have been effective, but have not been successfully developed for many diseases such as HIV infection, and certain live vaccines rarely can cause serious illness. Now so-called gene vaccines, also called DNA vaccines (for the material that makes up the genes), offer a much more specific means of prevention. Such a vaccine consists of DNA coding for only that substance (the “antigen”) that causes illness. In preventing a disease such as AIDS, for instance, introducing a specific antigen avoids the possible dangers of giving a vaccine that contains live HIV. Besides inducing the formation of antibodies, a DNA vaccine can stimulate the body’s immune cells (killer T cells) to help ward off infection. These vaccines should not harm the body’s own cells. In addition, they offer a hope of not only preventing but also treating chronic diseases.

Why did the authors do this review?
To learn how gene vaccines are being used and how safe and effective they have proven to be.

How did the authors do this review?
The authors reviewed study reports from the past few years that compared the preclinical and clinical effects of gene vaccines with those previously achieved by using standard vaccines.

What did the authors find?
An unrelated virus or a bacterium (called a “vector”), itself harmless, can be used to transport a gene vaccine into the body. Another way to transport a vaccine is to simply immunize with a circle of DNA coding for an antigen. In a key study, mice were given DNA that coded for a protein of influenza virus. When later given a different strain of live influenza virus, the mice survived what would have been a fatal infection. In clinical studies, DNA vaccines have produced antibodies and cell responses against the agents that cause AIDS, hepatitis, malaria, and other serious infections. The immune responses have been somewhat weak, however. Large-scale trials are just now getting under way to test DNA vaccines in populations at risk for serious infectious diseases. In time, gene vaccines may also be used to treat certain types of cancer, allergies, and autoimmune diseases (in which the body attacks its own cells). In the patient trials done to date, gene vaccines have been well tolerated and safe.

What are the implications of the review?
Like the live viral vaccines used for decades, DNA vaccines will produce antigens within the host. But DNA vaccines will deliver only genes coding for critical disease-producing antigens. The result: vaccines tailored to generate a particular immune response against selected antigens. Ideally, these vaccines will be distributed globally and will be available to populations most in need of effective prevention.