some of these microorganisms are resistant to these methods, particularly those that form biofilms, and “there’s a clear need for novel treatments,” says Claudia Gunsch, an environmental engineer at Duke University in Durham, N.C. Targeting microbes in biofilms with specific bacteriophages “could ultimately lead to greener disinfection technologies,” she says. This potential use raises questions about the safety of residual bacteriophages for consumers.

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RESEARCH ADVANCES

Triple Adjuvant Might Lead to Single-Dose Pertussis Vaccine

Shannon Weiman

An experimental pertussis vaccine combining three adjuvants with a single antigen is being developed to be given in a single dose—offering lifelong protection and lower cost than the current vaccine, according to Volker Gerdts, Associate Director of Research at VIDO-InterVac at the University of Saskatchewan in Saskatoon, Saskatchewan, Canada. This same approach is applicable to vaccines that protect against other bacterial or viral pathogens and, potentially, parasites such as the one that causes malaria, he says. Gerdts spoke during the symposium “Host Defense (Antimicrobial) Peptides: Major Players in Health and Novel Therapeutics,” during the 2012 ICAAC, held in San Francisco last September.

Gerdts and his collaborators set high goals for their updated pertussis vaccine to meet. It should be affordable, easy and safe to administer in resource-limited settings, offer lifetime immunity following a single dose, and be effective in protecting newborn children, in whom maternal antibodies tend to block vaccine efficacy. Meanwhile, the widely used pertussis vaccine, which typically is administered five times to U.S. children before they begin school, is under scrutiny after recent outbreaks of the disease (Microbe, October 2012, p. 455).

Key to meeting at least some of those goals is a novel adjuvant containing three ingredients—a synthetic innate defense regulatory peptide, a Toll-like receptor (TLR) ligand, and polyphosphazene, a nitrogen- and phosphorus-containing polymer with organic side chains. These three components activate potent and lasting immune responses, depending in part on the polymer encapsulating the antigen within a microparticle, according to Gerdts. Its surface is coated with the two other components, which recruit dendritic and macrophage cells of the host immune system that engulf the particles, process the antigens inside, and activate protective host responses, he says. “Particulate delivery increases vaccine stability and uptake of the antigen to the MHC class I and class II compartments, resulting in induction of both cell-mediated and humoral immune responses.”

When tested in animals, the single-dose pertussis vaccine is extremely potent. It confers lifetime protection with a single dose in mice and piglets, even in the presence of maternal antibodies. “Regardless of level of maternal antibodies, we see complete protection in all of our animals,” Gerdts says. The three-component adjuvant may preserve antigens within the microparticles, insulating against maternal antibodies interference, he speculates.

This version of the pertussis vaccine, if safe and effective, would be well suited for children in developing nations because of single dosing and its low cost, mere cents per dose, Gerdts says. It also can be delivered via inhaler, which is easier, potentially safer, less invasive, and elicits a good mucosal immune response in the lung, the main site of pertussis infections.

Other vaccines are being fit within this adjuvant platform, according to Gerdts. For example, a candidate vaccine to protect against respiratory syncytial virus is slated to begin clinical trials in 2014, he says. The adjuvant also is being eyed for use in veterinary medicine to protect livestock and poultry against a multitude of diseases.

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