Growing Hope

PLANTIBODIES MAY BE NEWEST WEAPON AGAINST HIV

BY BARBARA MORAN

The latest news on AIDS is sobering. In 2009, 2.6 million people became infected with HIV, according to data released in November 2011 by the Joint United Nations Programme on HIV/AIDS. That’s down from 3.1 million in 1999, but still amounts to 7,000 new infections and nearly 5,000 deaths every day.

Deborah Anderson, a School of Medicine professor of obstetrics and gynecology and of microbiology, is working to reverse this trend. Armed with a five-year, $13.3 million grant from the...
National Institute of Allergy and Infectious Diseases, Anderson is developing an approach to AIDS prevention that would supplement the body’s own immune system with novel antibodies grown in tobacco plants. If it works, her system will offer not only a cheap and powerful new weapon against AIDS, but also insights into stopping the spread of viruses from the common cold to the deadly Ebola virus.

Anderson expects that the new microbicide will be easy to use and hopes it will provide protection from HIV for up to a month.

The key to Anderson’s strategy is mucus, that lowly, slippery fluid that coats the nose, protects the eyes, and guards women’s reproductive systems from infection. An expert on mucosal immunology and HIV, Anderson has been studying these subjects for decades. For her PhD research at the University of Texas, she investigated the immunology of pregnancy, examining why a mother’s immune system doesn’t reject a fetus and why some women develop an immune response to her partner’s sperm. She garnered a deep understanding of immunology and gynecology, two subjects that became critically important when the AIDS epidemic burst onto the scene.

In the 1980s, a friend at the National Institutes of Health (NIH) suggested that Anderson study the sexual transmission of HIV/AIDS.

“I got involved when the epidemic was getting started,” she says. Since then she has specialized in genital tract immunology, examining how the body’s own immune system responds to HIV, herpes simplex virus (HSV), and other sexually transmitted diseases (STDs).

Which brings us back to mucus, a secretion that protects cells and wards off infection. Human mucus is made of long molecules called mucins; there is some evidence that antibodies may tether themselves to mucins and also enter and remain inside skin cells lining the mucus membranes. Anderson is creating a microbicide that a woman can insert in her genital tract with an easy-to-use ring, gel, or film. The microbicide will contain two antibodies that attack different parts of the HIV virus and a third antibody that neutralizes HSV. If the technology works, in the future it could include antibodies that protect against other STDs as well.

“We could keep adding antibodies because the body makes a whole host of them,” says Anderson, pointing out that human secretions are already brimming with antibodies. “The beauty of this system is that we’re just helping Mother Nature.”

Despite the worldwide epidemic, HIV is actually a fragile virus. “It doesn’t infect very easily,” Anderson says. “If a woman has unprotected sex with an infected man, there’s only about a one in 1,000 chance of getting infected with HIV.”

Other factors can raise the risk, however. Genital herpes, for instance, causes inflammation and sores that allow HIV to more easily breach the body’s natural defenses, so Anderson’s microbicide is designed to guard against both HSV and HIV. She hopes this approach will tackle one of the recurring problems with microbicides and spermicides: they work, but people don’t use them. “Take condoms,” she says. “They’re very effective, but people don’t use them correctly.” She expects that the new microbicide will be easy to use and hopes it will provide protection from HIV/HSV for up to a month.

To develop the particular antibodies to be used in the microbicide, Anderson is working with biophysicist Kevin Whaley, a longtime collaborator and founder of Mapp Biopharmaceutical, in San Diego. Mapp is a leader in the production of “plantibodies,” antibodies (in this case, HIV-specific antibodies) grown in plants. Plantibodies can be manufactured in huge amounts quickly and cheaply compared to growing similar antibodies in animals or cell cultures.

“The technology has been around for over 10 years, but now it has gelled,” says Anderson. “They have been able to ramp up production and lower costs.” Tobacco in particular is easy to grow and harvest and offers great promise for fast, low-cost antibody production. The current cost of antibodies grown in mammals is about $50 a dose, while the cost of tobacco-grown antibodies will likely be much less: somewhere between 20 cents and $1 a dose.

Anderson’s grant comes from the NIH’s Integrated Preclinical/Clinical Program for HIV Topical Microbicides, created to foster collaboration between industry and academia. Anderson will oversee 6 projects at 10 institutions that will test new antibody formulations, grow the plants, harvest the antibodies, and build and test the application devices.

Anderson’s first goal over the grant’s five years is to determine which configuration of antibodies works best when mixed with mucus or applied to mucosal skin cells, a process that will take about a year. Then her team will grow large batches of the chosen antibodies in tobacco plants and will test the antibodies in monkeys to see if they prevent the transmission of HIV. The grant will also include preclinical human trials to make sure the antibodies don’t cause irritation or inflammation and to see how long they remain active in the body.

“Our dream is to put plantibodies on the map for preventing transmission of STDs,” Anderson says.

If the technology works, it could have far broader implications. Many other infections enter the body through mucus membranes in the nose, eyes, and lungs. If Anderson’s plantibodies work, they may offer a new weapon for preventing the spread of tuberculosis, influenza, and even that universal annoyance, the common cold.