Mysterious hormone forecasts AIDS onset

Abnormally low levels of an obscure adrenal hormone appear to foreshadow a progression from asymptomatic infection to full-blown AIDS, according to an intriguing new study. The finding, if confirmed, may offer another means of tracking the deterioration of people infected with HIV, the virus that causes AIDS. In addition, it has ignited hope that the hormone may actually help protect against HIV.

The hormone is dehydroepiandrosterone (DHEA), a steroid manufactured by the adrenal gland. It has no known function in healthy people, yet research suggests it might help protect against heart disease, cancer, viral infections and infirmities related to old age.

"It does everything," says one of DHEA's most enthusiastic proponents, William Regelson of the Medical College of Virginia in Richmond. His mouse studies have suggested that DHEA enhances the body's defense against viral infections. Regelson's work and other research prompted a California team to investigate the steroid's role in AIDS.

The AIDS study, led by Mark A. Jacobson of the University of California, San Francisco, involved HIV-infected men in the San Francisco Men's Health Study, whose blood samples were drawn at regular intervals and frozen. Jacobson's team focused on 108 men who still had few or no disease symptoms two years after entering the study. He and his colleagues analyzed blood samples taken at the two-year point, looking at DHEA levels and the number of CD4 T-lymphocytes — white blood cells used as a laboratory marker for the severity of infection (SN: 11/4/89, p.298). They also checked to see which of these men developed AIDS over the following three years.

In the November Journal of Infectious Diseases, they report an "impressive" association between low blood levels of DHEA and progression to AIDS among a subset of the HIV-infected men: those with CD4 counts of 200 to 499 per microliter of blood. (Healthy people have a CD4 count of about 1,200; with full-blown AIDS, the count drops below 200.) Even after the researchers took into account other factors known to affect HIV's progress, such as zidovudine treatment, the statistical link between DHEA and disease progression remained significant, they say.

Compared with men in the subset who possessed normal DHEA levels, those with low levels faced double the risk of progressing to AIDS during the next three years, the team found.

The significance of that finding remains unclear, cautions Carl Merril of the National Institute of Mental Health, who in 1989 reported the observation that HIV-infected people had lower-than-normal DHEA levels. DHEA's function — both in sickness and in health — remains enigmatic, he says. Low DHEA could represent just another laboratory marker for worsening disease, an indicator "that things are going dreadfully wrong with the adrenal gland," Merril suggests.

On the other hand, DHEA might play an active role in fighting HIV, Jacobson speculates. He notes that preliminary studies by Michael McGrath of UCSF indicate that DHEA may inhibit HIV replication, at least in the test tube. That finding, along with Regelson's work, suggests that DHEA in abundant levels may help shield against HIV progression, Jacobson says.

To begin testing that theory, his team and Elan Pharmaceuticals have embarked on an early clinical trial involving experimental DHEA treatment of 23 HIV-infected men in San Francisco. The Ireland-based drug firm manufactures a synthetic form of DHEA.

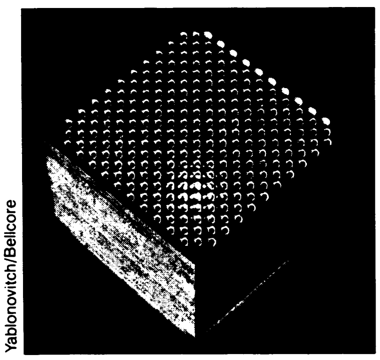
For now, the new report's primary significance may lie in its challenge to AIDS researchers. "This is a lead," Jacobson says. "Here's something that seems to influence the progression of HIV."

— *K.A. Fackelmann*

Drilling holes to keep photons in the dark

Researchers have taken an important step toward fabricating a material that, in effect, excludes photons of certain wavelengths. Such a structure, known as a photonic crystal, would prevent atoms embedded within it from spontaneously absorbing and reemitting light at wavelengths that fall within the excluded range, or band gap.

"What we're trying to do is make a semiconductor for light waves," says Eli Yablonovitch of Bell Communications Research (Bellcore) in Red Bank, N.J., who in 1987 first suggested building photonic crystals. Such materials could one day play key roles in the development of highly efficient lasers and solar cells.



Yablonovitch/Bellcore

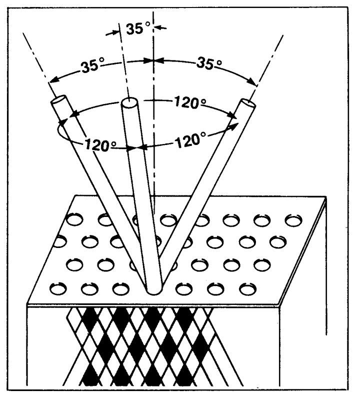


Photo at left shows original design for a face-centered cubic photonic crystal. Diagram shows improved version, which involves drilling three sets of holes into a solid slab.

To find a structure with a photonic band gap, Yablonovitch and his coworkers initially focused on arrays of spherical air pockets carved into an electrical insulator. They created such structures by drilling into the surfaces of flat plates, which they stacked and bolted together (see photo). In each case, the spherical air pockets lay in a face-centered cubic arrangement, a pattern resembling the way grocers stack oranges to make an orderly, closely packed pile.

This structure looked promising, but "we got into trouble," Yablonovitch says. Its band gap was extremely narrow and difficult to pick up experimentally.

Subsequent theoretical calculations by K. Ming Leung of Polytechnic University in Brooklyn, N.Y., showed that a slightly different geometry would produce better results (SN: 9/29/90, p.196). Guided by these findings and the theoretical work of Kai-Ming Ho and his colleagues at Iowa State University in Ames, the Bellcore team constructed and tested a new face-centered cubic structure in which the air pockets were no longer spherical.

As described in the Oct. 21 Physical Review Letters, fabrication of this novel structure requires drilling three sets of holes, slanted at specific angles, into the top of a solid slab (see diagram). The holes crisscross below the slab's surface to produce an array of distorted, nonspherical cavities.

By studying what happens to microwaves traveling through the array, the researchers confirmed that this structure does prevent a certain range of microwaves from penetrating the material.

This new photonic crystal solves two outstanding problems, the Bellcore team says. It shows that a full, three-dimensional "forbidden" gap can exist in an electrically insulating material and that manufacturing the requisite structure is practical.

Although the researchers worked with microwaves and with structures fashioned by conventional drilling, they see no reason why the same effect shouldn't occur for visible light in an appropriately doctored material. "It appears that the application of photonic band gaps to semiconductor, optical and atomic physics may soon be practical," they conclude.

— *I. Peterson*