Biomedicine

The good news: Protease inhibitors

It's probably no coincidence that deaths from AIDS in the United States have dropped sharply since 1995, when a potent set of drugs called protease inhibitors became available, researchers say.

Protease inhibitors strengthen the body's immune system by keeping HIV, the AIDS virus, from making copies of itself and by boosting the number of virus-fighting T cells in the blood. They have proved especially effective when used with other anti-HIV medication. Such drug combinations have helped slow the rate at which HIV-positive people develop AIDS and have reduced the number of AIDS-related deaths in the United States from 21,460 in the first half of 1996 to 12,040 in the first half of 1997, reported Kevin M. De Cock of the federal Centers for Disease Control and Prevention in Atlanta. During that time, the number of new AIDS cases also fell slightly.

In New York City, the disease claimed 19 lives per day in 1995 and seven per day in 1997 on average, said epidemiologist Mary Ann Chiasson of the city's health department. According to Atieno Reggy, a CDC physician who worked with health department researchers, preliminary survey data show that New Yorkers who were diagnosed with AIDS after 1994 and survived through 1996 were nearly three times as likely to have taken a combination of drugs that included a protease inhibitor as AIDS patients who were diagnosed and died during that period.

Nationwide, CDC estimates that up to 40,000 new HIV infections still occur annually. Of new AIDS cases, 35 percent occur from male-to-male sex, 24 percent from intravenous drug use, 13 percent from heterosexual contact, and the rest from unspecified causes, De Cock said. A breakdown by race and ethnic background shows that 45 percent of new AIDS cases occur in blacks, 33 percent in whites, 21 percent in Hispanics, and 1 percent in other groups. —*N.S.*

The bad news: Protease inhibitors

A strange side effect is showing up in some people using protease inhibitors: fat buildup on the torso or face, particularly on the abdomen or across the top of the shoulders. The fat appears to be redistributed from other parts of the body.

Several research teams have linked these pads of fat to the relatively new drugs. "There's no question protease inhibitors cause the [pads]," said Richard L. Hengel of Emory University in Atlanta.

So far, the fat doesn't seem to threaten the patients' health, and doctors aren't stopping treatment with protease inhibitors because of it. However, the redistribution could signal another disorder. "It's the underlying metabolic issues that physicians are concerned about," noted Scott Hammer, a virologist at Beth Israel Deaconess Medical Center in Boston.

Incidence of the side effect diverges widely, from a few percent to two-thirds of those taking protease inhibitors. The condition may be underreported, said virologist John W. Mellors of the University of Pittsburgh. "As [AIDS] patients' lives change—as they go from contemplating or wrestling with having a fatal disease to having a future—these other issues become more prominent and they will come forward." —*N.S.*

Antiviral gel clears safety test

An intravaginal gel that kills HIV in the laboratory appeared safe when used in a test in women. Of 36 women who used the gel once a day for 2 weeks, only 2 reported serious irritation from the substance. Ten others reported mild irritation, and 24 had no complaints, said Albert T. Profy of Procept, a firm based in Cambridge, Mass.

If approved for use, the gel could be a boon to women in the developing world, where HIV is spread mostly through heterosexual sex, Profy said. —*N.S.*

Physics

Flooding light through tiny holes

A silver coating serves as an excellent reflector of visible light. A thin, perforated silver film deposited on quartz, however, can be remarkably transparent, even when the openings are considerably narrower than the light's wavelength.

Researchers have observed that a regular array of microscopic holes penetrating a thin metal layer lets through a surprisingly large amount of light in certain wavelength ranges. Photons appear to traverse the apertures much more easily than theorists would have expected.

"We weren't looking for this," says Thomas W. Ebbesen of Louis Pasteur University in Strasbourg, France. "It's a surprisingly strong effect." Ebbesen and his collaborators report their findings in the Feb. 12 NATURE.

The researchers used metal films, from 100 to 500 nanometers thick, with holes 150 nm in diameter and from 0.6 to 1.8 micrometers apart. The holes were arranged in square or triangular grids. Bathed in light ranging from 200 to 1,200 nm in wavelength, the perforated metal films selectively transmitted light with wavelengths up to five times the aperture diameter. "What really matters is the spacing between the holes," Ebbesen says.

The phenomenon apparently involves plasmons—mobile pockets of oscillating electromagnetic fields associated with quantities of electric charge sloshing around on a metal's surface. The presence of a regular array of holes disturbs the motion of these plasmons, causing them to interact strongly with the electromagnetic fields of photons striking the metal surface.

In effect, incoming light is absorbed via surface plasmons, then reradiated out the holes. "What's surprising is that about 1,000 times more light gets through than you would expect, at least according to [conventional] theory," Ebbesen says.

In addition, there's a lensing effect, he notes. Some of the light that hits the metal around the holes gets channeled by the plasmons through the holes instead of being reflected.

By controlling such factors as hole spacing, comments Roy Sambles of the University of Exeter in England, it may be possible to create optical filters that selectively transmit certain wavelengths with no diffractive effects. —*I.P.*

Tunneling to a speedy transistor

Taking advantage of quantum effects can greatly speed up such crucial microelectronic components as transistors. For the last decade, scientists have been exploring the possibility of exploiting an electron's ability to slip through what would apparently be an impenetrable barrier—a quantum phenomenon known as tunneling. Now, researchers have developed an improved tunneling transistor, potentially opening the way for mass production of such devices using conventional manufacturing techniques.

"We have demonstrated real circuits that work and are easily fabricated," says J.A. Simmons of Sandia National Laboratories in Albuquerque, N.M. He and his coworkers describe their novel device in a report to be published in APPLIED PHYSICS LETTERS.

Known as the "double electron layer tunneling transistor," the device consists essentially of two slabs of gallium arsenide, each 15 nanometers thick, separated by an aluminum gallium arsenide barrier 12.5 nm wide. Electrons in one gallium arsenide layer normally don't have the energy to traverse the barrier to get into the other layer. However, because the barrier is so thin, electrons, behaving more like waves than particles, can leak through. The tunneling electrons travel extremely rapidly and easily evade atomic impurities and crystal defects that slow down electric charge movement in conventional transistors.

The Sandia device has roughly 10 times the speed of the fastest transistor circuits now in use, Simmons says. —*I.P.*