Fat May Spur Spread of Prostate Cancer

By age 80, two-thirds of all men may harbor nascent prostate cancer. Developing in the walnut-size gland that produces fluid to carry sperm from the testicles, this cancer tends to progress so slowly that most of its victims die of something else. Indeed, many never even realize they have the disease.

But prostate cancer can kill. In fact, it is the second most common cause of cancer deaths in U.S. men. A study in the Oct. 6 JOURNAL OF THE NATIONAL CANCER INSTITUTE now strongly indicates that whether this cancer turns deadly or not may hinge on the type and quantity of fat a man eats.

Edward Giovannucci of Harvard Medical School in Boston and his co-workers collected detailed food consumption data in 1986 from male health care professionals – including dentists, pharmacists, veterinarians, and other nonphysicians – in the United States. For their analysis, the researchers correlated dietary data from roughly 48,000 of these men with medical records for 417 of the 422 participants who had been diagnosed with prostate cancer by 1990.

The researchers found no evidence that diet elevated a man's risk of getting prostate cancer. But among men who did develop the disease, high-fat diets emerged as a major factor elevating the risk that the cancer would progress to an advanced stage – one in which it could spread. "And these are the ones we care about," Giovannucci says, because they can kill.

Not all fats affected risk similarly, however. For instance, the analysis showed that saturated fats, fish oils, and vegetable fats were not linked to greater risk of invasive cancer, whereas high consumption of monounsaturates did appear to increase risk somewhat.

Among "essential" fatty acids – vital fat constituents that the body must obtain from foods because it cannot make them – the picture was equally mixed. Diets high in the essential linoleic acid appeared to cut cancer-progression risk by 40 percent, while high consumption of the essential alpha-linolenic acid more than tripled the likelihood that a cancer would spread.

How does this play out in terms of actual foods? Diets high in red meat, butter, or chicken with the skin on appeared to increase the chance that a prostate tumor would progress. By contrast, eating skinless chicken or dairy foods other than butter did not. Indeed, the 20 percent (quintile) of men who consumed the most red meat and chicken with skin proved 3.5 times more likely to develop a late-stage prostate cancer than men in the lowest quintile.

Though red meat is a major source of alpha-linolenic acid, Giovannucci said that the meat and the fatty acid pose separate risks for cancer progression. Indeed, Giovannucci says, if there was any real surprise among the study's findings, it was alpha-linolenic's apparent role: "We weren't anticipating it."

While prostate cancer occurs at about the same rate worldwide, the proportion of cases that prove fatal varies by region, according to a report in the May 19 ANNALS OF INTERNAL MEDICINE. Men in the United States, for instance, run almost 4.5 times the risk of dying from prostate cancer as men in Japan, observe report authors Kenneth J. Pienta and Peggy S. Esper of Wayne State University School of Medicine in Detroit.

Over the years, such observations have led researchers to suspect that some share of the population differences in prostate-cancer mortality may be caused by environmental factors, especially dietary fat. Statistically, however, most studies have been too weak to do more than just hint at that, Pienta says.

Until now. He describes the new paper as "a landmark study," both for its methodology and its statistical strength. Moreover, he says, its findings suggest that in men with early signs of prostate cancer, or at high risk of developing the malignancy, "we might intervene in the progression of their disease" through diet.

– J. Raloff

Ripples in space: Electrons make waves

Drop a pebble in water and what happens? Smooth ripples glide to the water's edge in concentric circles. But what if those ripples hovered as standing waves, in motion yet apparently still?

In theory, electrons should form such standing waves when confined in a space of just the right size. Scientists knew roughly how this phenomenon should look, but they had never seen it happen. Now, they can watch quantum theory emerge in vivid color.

IBM/Almaden Research Center

Iron atoms in a circular "corral" cause electron standing waves.

In the Oct. 8 SCIENCE, Michael F. Crommie and his colleagues at IBM's Almaden Research Center in San Jose, Calif., report building a quantum corral, a "round, two-dimensional box" that elegantly shows what quantum theory predicts – namely, that electrons trapped in a flat, circular space will create standing waves at precise intervals. "Corrals let us actively shape electron wave functions," determining their spatial positions and energy levels, says Donald M. Eigler, an IBM physicist and coauthor of the report. "In this sense, a corral is a remarkable tool."

To build the structure, the scientists used a scanning tunneling microscope (STM) to individually place 48 iron atoms on a copper surface in a circle roughly 143 angstroms across. Then, using the STM again to sense electron behavior inside the corral, they detected "local densities," which appear as waves, at the very intervals predicted by quantum mechanics – specifically, the Schrödinger equation for a particle in a hard-wall enclosure. The standing waves appear when iron atoms scatter the copper's surface electrons.

"Most scientists looking at this image will probably say, 'That's how it should look'," Eigler observes. "This is not an unexpected result, but rather a unique visual confirmation of what Schrödinger's equations predict." By focusing surface electrons, corrals make possible deeper studies of electron behavior. "We can use corrals to learn much more about how electrons move as guided waves, about how they couple, and perhaps about quantum chaos," says Christopher P. Lutz, another IBM physicist involved in the research.

Quantum theory also predicts that, under certain conditions, electrons will move chaotically. To see quantum chaos, the researchers are building corrals with various shapes, such as grids, tubes, and even a "quantum stadium" – a corral shaped like a running track. Measuring 140 angstroms by 300 angstroms, this flattened ellipse will, they hope, create an arena in which electrons can careen chaotically around, again enabling them to test behavior against theory. "The question is how a particle, which also acts as a wave, will behave in the stadium," says Lutz.

– R. Lipkin