Biomedicine

Breast cancer: Low-fat finding

The typical North American diet derives almost 40 percent of its calories from fat. Because many studies have linked such "high-fat" diets with increased breast-cancer risk, researchers from two Toronto hospitals decided to study whether year-long reductions in dietary fat would alter breast tissue in a potentially high-risk population. Their preliminary study, involving 180 women, found "hints" of a reduction in cancer risk. A report in the Oct. 5 JOURNAL OF THE NATIONAL CANCER INSTITUTE showed women who spent the year on a very low-fat diet developed fewer than half as many breast cancers as those on normal diets.

Participants were women whose routine mammograms exhibited "dysplasia" — unusual shadows in the radiographic image — affecting at least half a breast. Such changes are thought to signal increased breast-cancer risk. Half the women were encouraged to eat a typical diet — containing about 37 percent of its calories from fat and 43 percent from carbohydrates. The rest ate a specially formulated diet deriving only about 15 to 20 percent of its energy from fat and 56 percent from carbohydrates. Periodic chemical measurements verified that all women stuck to their diets.

Mammograms one year later showed equal dysplasia in both groups but a big difference in cancer incidence: Five women on the normal high-fat diet, but just two in the low-fat group, developed breast cancer. Although such a difference is consistent with animal diet research, the researchers were "very surprised" by it, says study coauthor Mary Cousins, at the Ontario Cancer Institute's Princess Margaret Hospital. "We didn't expect to see this in such a short period of time," she says.

With so few women involved, one should not make too much of the difference in cancer rates between the dietary groups—at least thus far, says Norman Boyd, the study's director. However, he notes, based on these early findings, a larger, follow-up study is in the works.

Taking aim at heart pain

Artery-clogging blood clots recently have been linked to a condition called unstable angina, a form of chest pain that may signal an impending heart attack. Now researchers report that angina patients benefit from treatment with heparin or aspirin, both of which inhibit clotting.

"We provided evidence that we could prevent myocardial infarction in these patients," says Pierre Théroux of the Montreal Heart Institute. Théroux and his colleagues studied 479 hospitalized patients who had experienced chest pain. Patients were put in four treatment groups, receiving aspirin, heparin, a combination of the two or a placebo.

Heparin therapy performed the best, reducing the rate of fatal and nonfatal heart attacks by 89 percent as compared with the placebo. Heparin also reduced chest pain by 63 percent, according to the research group's report in the Oct. 27 NEW ENGLAND JOURNAL OF MEDICINE. Previous studies of heparin treatment for chest pain have produced questionable results, Théroux says.

Aspirin therapy also helped. The Montreal team found aspirin reduced the risk of heart attacks by 72 percent as compared with the placebo — a result that is consistent with previous research. But the combination aspirin/heparin treatment showed no particular benefit compared with aspirin alone or heparin alone, and patients getting the two drugs combined had a slightly higher risk of complications, such as bleeding.

For patients hospitalized with chest pain, the researchers recommend treatment with heparin upon admission followed by aspirin therapy for long-term management.

Physics

Wormholes and time machines

Captain Kirk, beware! A sufficiently advanced civilization might be able to construct and maintain wormholes — shortcuts through space-time — for rapid interstellar travel between widely separated parts of the universe. And, if the laws of physics permit such a construction, then a wormhole could also be converted into a time machine.

These speculations surface not in a script for a "Star Trek" episode but in a recent issue of a respectable physics journal. In the Sept. 26 PHYSICAL REVIEW LETTERS, Michael S. Morris, Kip S. Thorne and Ulvi Yurtsever of the California Institute of Technology in Pasadena present mathematical arguments supporting the notion that the presence of a wormhole could locally scramble the relationship between cause and effect.

According to present theories, when a star several times more massive than the sun collapses to form a black hole, under certain circumstances, the black hole can turn inside out and poke itself into another part of space-time. The result is a tunnel through space-time — a wormhole — linking two black holes. For most theorists, wormholes hardly seem worth thinking about because they squeeze shut before there is any time for a spacecraft or even information to pass through.

Morris and his colleagues, however, suggest that a wormhole could be kept open if two identical, perfectly conducting, equally charged spheres were placed on either side of its throat. The presence of the charged spheres invokes a quantum process known as the Casimir effect, which changes the nature of the vacuum between the spheres, allowing the wormhole to stay open. With such a technology, an advanced civilization could use a wormhole to transmit messages and travel across the universe.

If a wormhole's two mouths initially happen to lie close together, then the wormhole can be turned into a kind of time machine. By using electrical or gravitational force to pull one mouth away from its stationary neighbor at a speed verging on the speed of light, then reverse its direction and return the mouth to its original position, extraterrestrial technicians would cause it to "age" less than its partner. Consequently, by traversing the wormhole from the younger to the older mouth, "one can travel backward in time . . . and thereby, perhaps, violate causality," the researchers write. "This wormhole space-time may serve as a useful test bed for ideas about causality, free will and the quantum theory of measurement."

The entire argument hinges on whether the laws of physics, as presently formulated, permit the creation of traversable wormholes. That question, in turn, raises deep, ill-understood issues about cosmic censorship, quantum gravity and quantum field theory. One plausible scenario for wormhole creation entails "quantum foam" — fluctuations in the fabric of space-time many times smaller than the size of a subatomic particle. "There might be some way to amplify these quantum effects, although we don't know how," the physicists say. "One can imagine an advanced civilization pulling a wormhole out of the quantum foam and enlarging it to classical size."

"There are many uncertainties," says Morris, now at the University of Wisconsin-Milwaukee. "The calculations are only preliminary." For instance, although it may be possible to construct a traversable wormhole, it could be unstable. As in the case of a precariously balanced pencil standing on its point, any slight nudge would topple the system.

"It's all very speculative," Morris says. "Any new idea could crush the whole thing in the sense of proving that it would be impossible. But any one of these directions of speculation, including results that crush the idea, would be very interesting." Such speculations give physicists ways to probe their understanding of physical laws, illuminating ill-defined concepts and gaps in scientific knowledge.