Biomedicine

Kathy A. Fackelmann reports from Washington, D.C., at the 61st Scientific Sessions of the American Heart Association

Yoga, diet, exercise melt away plaque

From the land of laid-back living comes evidence that lifestyle changes alone may reverse coronary artery disease. Dean M. Ornish of the University of California, San Francisco, and his colleagues found that patients who exercised, practiced yoga and ate a vegetarian diet lowered their blood cholesterol levels and reduced the fatty deposits narrowing their arteries. "After a year, we're showing striking reductions in cholesterol levels," Ornish says.

The scientists randomly assigned 50 participants with coronary artery disease to two groups and tested them initially and at the end of one year to determine the condition of their coronary arteries and blood lipid levels. Patients in the lifestyle-change group were compared with a control group receiving traditional care, including diet advice.

Ornish now reports preliminary results on 29 patients. The lifestyle group improved over the course of a year, showing an average total cholesterol of 213 milligrams per deciliter at the start of the study that dropped to 154 at year's end. Narrowing of coronary arteries also improved, dropping from an average of 44.4 percent to 40.8 percent. Control participants overall showed moderate changes in their cholesterol levels and had increased artery blockage a year later.

Devices clear plaque from arteries

Early clinical trials on plaque-busting devices have some researchers envisioning them eventually replacing balloon angioplasty — a method that has gained widespread use in the 1980s — as a means of opening obstructed arteries.

One researcher presenting new findings is John B. Simpson, a cardiologist at Sequoia Hospital of Redwood City, Calif., who has tested a plaque-scraping catheter in 33 patients. "Our initial experience with the device has been encouraging," he says. His device is being tested in eight medical centers, and so far it has removed fatty build-up without significant side effects, Simpson says.

Robert Ginsburg of Stanford University Medical Center says he has used a "grinder" device on 40 patients. Ginsburg is testing the U.S.-developed catheter with a burr on the end that grinds away fat and calcium deposits. The device "literally polishes the inside of a diseased vessel," he says. The device is being tested worldwide and at one other U.S. center.

One important difference between the two devices: Simpson's collects and removes plaque from the body, while the grinder throws debris into the bloodstream. Many cardiologists worry that the loose particles may cause clotting and other problems. Ginsburg says patients have suffered no ill effects so far. He points out that a piece of ground-up plaque is 5 to 7 microns, smaller than the average red blood cell.

Low levels of good cholesterol a bad sign

The National Cholesterol Education Program recommends that adults keep their total cholesterol levels at 200 milligrams per deciliter or less. But Michael Miller and his colleagues at Johns Hopkins Medical Institutions in Baltimore report that coronary artery disease patients with "safe" levels of total cholesterol still may be at risk if their levels of high-density lipoprotein (HDL) cholesterol are low. HDL, often called the "good" cholesterol, helps clear "bad" cholesterol from the blood.

The Hopkins research confirms previous findings that low HDL levels may be a powerful predictor of coronary heart disease. The group suggests revising current guidelines to put more emphasis on comprehensive blood lipid testing. Many physicians today look at total cholesterol levels and don't recommend further testing if those numbers are within the "safe" limits, the researchers say.

Physics

Boundaries with a golden twist

A close look at the etched surface of a chunk of metal often reveals a patchwork of grains jammed together. Each grain boundary marks the meeting place of two crystals, oriented so their atoms are usually aligned in different directions. What happens at such boundaries tells materials scientists a great deal about the properties of polycrystalline materials — from how much they expand when heated to how easily they fracture when put under stress.

Recently, researchers at Cornell University in Ithaca, N.Y., using a novel X-ray technique to probe the internal structure of grain interfaces in gold, obtained the most detailed data yet on the positions of atoms along a boundary between two crystalline regions and preliminary results on how atoms at such a boundary respond to heat. They report some of their findings in the Nov. 7 PHYSICAL REVIEW LETTERS.

Michael R. Fitzsimmons and his collaborators concentrated on crystal interfaces known as twist grain boundaries. They manufactured their samples by welding together two single-crystal gold films, producing roughly the same effect as rotating a sandwich's top slice of bread so that its edges no longer line up with those of the bottom slice.

The researchers, using high-intensity X-rays produced by the Cornell High Energy Synchrotron Source, looked for subtle changes in the intensity and position of X-ray signals reflected from atoms at a boundary. To find atomic positions, they calculated what the diffraction pattern would look like for a number of possible structures, varying the positions of atoms in their models until their theoretical results matched the measured signals.

The Cornell work shows the thermal properties of a twist boundary are quite different from those of the bulk material. Atoms at boundaries seem to vibrate 50 percent more strongly than those in the bulk material. Furthermore, the material expands three times as much at right angles to a boundary as it does along a boundary. In other words, if it were possible to create a gold rod by neatly stacking appropriately oriented crystals, the rod, when heated, would expand more in one direction than in the other.

A superconducting smorgasbord

Since the first observation of high-temperature superconductivity in lanthanum barium copper oxide in 1986, progress in understanding this phenomenon has been coupled with the discovery of new materials. Now, researchers at AT&T Bell Laboratories in Murray Hill, N.J., report the synthesis and crystal structure of a new family of layered copper-oxide superconductors with novel properties. Robert J. Cava and his colleagues describe their discovery — the fourth known family of high-temperature superconductors — in the Nov. 17 NATURE. Although the new materials set no records for the temperature at which they become superconducting, they possess unusual electron arrangements that may provide insights into the role of charge distribution in controlling superconductivity.

Difficult to synthesize, the new superconductors consist of copper and oxygen combined with lead, strontium and any one of a wide range of rare-earth metals. So far, the Bell Labs team has investigated only a small fraction of the many possible variations, achieving superconductivity at temperatures no higher than 70 kelvins, or -333°F. With the right combination of elements, higher temperatures may be attainable.

What is unique about the electronic configuration of the copper atoms in the new compounds is that their average valence, or net charge, is less than 2. In all previously known copper-oxide superconductors, the average valence is greater than 2. The difference seems related to how the atoms within the material are arranged.