Biology

Gene therapy fashions supermouse hearts

Researchers report creating genetically engineered mice with powerhouse hearts. That finding may lead to human gene therapy for congestive heart failure, a condition in which damaged heart muscle fails to pump blood effectively.

People with this condition carry too few beta-adrenergic receptors, specific proteins that sit on the surface of heart cells. A dearth of such proteins means that the heart doesn't beat as powerfully as it should, even when naturally produced epinephrine plugs into those receptor sites.

Carmelo A. Milano of Duke University Medical Center in Durham, N.C., and his colleagues wanted to see if they could use genetic engineering techniques to boost the number of receptors found in mouse hearts. Using a micropipette, Milano's team injected a solution containing human genes for adrenergic receptors into very young mouse embryos. The researchers tested the resulting mice to find out whether the inserted human genes had turned on. They discovered that the hearts of transgenic mice had more than 100 times the normal number of these receptors.

Not surprisingly, the increase made the hearts of these animals beat more powerfully, the team reports in the April 22 SCIENCE.

Because the mice in this study hadn't been suffering from a heart condition, Milano points out, the study shows only that scientists can rev up a normal mouse heart. The next step will be to do the same for mice with heart disease, he says.

The scientists envision using slightly different methods to help people suffering from a failing heart. In such cases, researchers would probably turn to a crippled virus to deliver the gene for adrenergic receptors into adult heart cells. But Milano is the first to admit that such therapy remains years from the doctor's office.

More toxic tangles, this time in diabetes

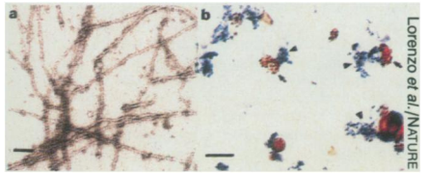
For years, neurobiologists have debated the role of a peptide called beta-amyloid in the development of Alzheimer's disease (SN: 1/1/94, p.8). Now, it appears that a similar protein particle may be involved in type II diabetes, a disease that typically strikes adults.

Like the beta-amyloid peptide, this 37-amino-acid particle, called amylin, aggregates; but instead of forming plaques in the brain, as beta-amyloid does, amylin accumulates near insulin-producing beta cells located in the pancreas.

Scientists suspected that amylin interferes with the body's ability to regulate sugar (SN: 10/20/90, p.250). But they found that when clumps of amylin contact the surfaces of beta cells, the substance can also cause the cells to die, report Alfredo Lorenzo of Harvard Medical School and Children's Hospital in Boston and his colleagues.

For the experiments, they developed ways of growing rat and human pancreatic tissue in a laboratory dish. While aggregated human amylin killed the cells, dissolved amylin did not, the scientists report in the April 21 NATURE.

Amylin's toxicity seems to be related to its tendency to form tangled masses; beta-amyloid plaques have a similar, though weaker, effect on the pancreatic cells, says Harvard's Bruce A. Yankner. As with beta-amyloid, the amylin deposits somehow initiate the process of programmed cell death.



Electron micrograph of amylin fibers (a). These fibers (triangles) cause degeneration of beta cells (arrows) (b).

Physics

Ivars Peterson reports from Arlington, Va., at an American Physical Society meeting

Magnetism in atomic clusters

Normally, chunks of rhodium – a hard, corrosion-resistant metal resembling platinum – aren't magnetic in the same way as iron or nickel. But when the chunks are small enough, rhodium spontaneously becomes strongly ferromagnetic. Researchers have discovered that tiny, isolated clusters, each consisting of just a dozen or so rhodium atoms, display a degree of magnetism rivaling that of nickel. This effect disappears for clusters larger than about 60 atoms.

"Rhodium is the only known example of a material that is not magnetic in the bulk [but] becomes magnetic when reduced to cluster dimensions," says Louis A. Bloomfield of the University of Virginia in Charlottesville. Bloomfield and his coworkers made the experimental observations that confirmed the existence of this effect in rhodium.

Scientists have long suspected that reducing sample sizes to nearly atomic scales would make metals more magnetic than usual. But previous attempts to detect ferromagnetism in clusters of normally nonmagnetic metals had failed.

Spurred by theoretical work suggesting that a clump of 13 rhodium atoms should show the effect, Bloomfield and his colleagues created rhodium clusters ranging in size from 8 to 60 atoms and managed to detect various levels of ferromagnetism in these samples. The magnetism was particularly strong in clusters consisting of 15, 16, or 19 atoms. However, they found no evidence of ferromagnetism in clusters of ruthenium and palladium, elements adjacent to rhodium on the periodic table.

"We're going to look for other elements that are magnetic as clusters but aren't magnetic in the bulk," Bloomfield says. "I'll bet some of the rare earths do that." This research may even have applications in magnetic recording, he notes.

Cold traps for 'hot' atoms

Handling radioactive atoms is always a tricky business. But creating radioactive particles by slamming atoms or protons into a target, slowing down – and thus cooling – the products, and capturing the chilled atoms in a trap before they decay into other elements offers even greater challenges than usual. Several research groups have now succeeded in using lasers and magnetic fields to accomplish this feat.

Luis A. Orozco and his collaborators at the State University of New York at Stony Brook worked with the radioactive isotope rubidium-79. To slow down the atoms, the researchers introduced them into a specially coated glass cell. As the atoms bounced around, their speeds changed and the slowest ones were caught in a web of laser light and magnetic fields within the cell.

To study subtle nuclear effects, the researchers hope to use the same method to trap francium atoms, which exist only as short-lived, intensely radioactive isotopes. "This would open an avenue to really exciting, new physics," Orozco says. Researchers could make extremely sensitive measurements of light emitted and absorbed by trapped atoms to obtain insights into nuclear and particle physics.

Stuart Freedman and his team at the University of California, Berkeley, used a somewhat different technique to capture radioactive sodium-21 atoms. In this case, a laser beam slowed down sodium atoms before they entered the trap's magnetic and optical fields. "We were the first to demonstrate this [particular method]," says team member Song-Quan Shang of Lawrence Berkeley Laboratory in Berkeley, Calif.

The availability of cold, trapped radioactive atoms makes possible the detailed study of such nuclear processes as alpha and beta decay. Because the laser wavelengths necessary for capturing atoms are unique to each isotope, such schemes can also serve as isotope analyzers, which aid in determining the age of rocks and other materials.