Germ Cell Transfer Boosts Fertility

Deep within a man's testes, primitive germ cells undergo continuous replication. Remarkably, germ cells that mature into sperm represent the only self-renewing cells in the adult body that can pass genetic information to the next generation. Thus they are, in a sense, immortal.

In contrast, the germ cells that mature to form eggs are present at birth. The female reproductive tract cannot replenish that supply.

Researchers from the University of Pennsylvania's School of Veterinary Medicine in Philadelphia now report transferring germ cells taken from virile male mice to the testes of infertile mice. Those cells matured to form sperm, and in some cases the recipients went on to father offspring.

"This opens up the field of male germ cell experimentation in a manner that wasn't possible before," says lead author Ralph L. Brinster. The researchers describe their findings in two papers published in the Nov. 22 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

In the first report, Brinster and James W. Zimmermann took germ cells, including so-called stem cells, from fertile male mice. Next, they injected those cells directly into the seminiferous tubules — the sperm-producing tubes of the testes — of mice producing few or no sperm.

The researchers discovered that the donated cells set up shop in the recipients' tubules. Once there, the stem cells behaved normally: Some replicated to form additional stem cells, while others ripened into cells that would eventually become sperm. Brinster and Zimmermann showed that about one-third of recipient testes produced sperm.

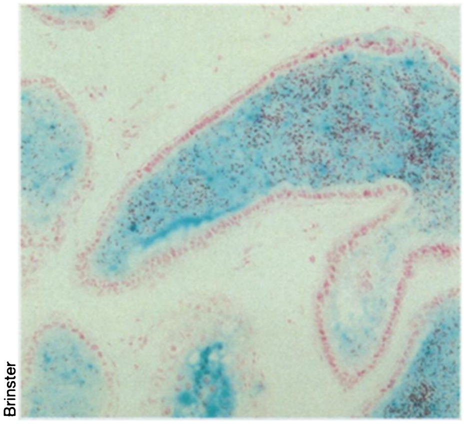
"This is a powerful group of cells that has a lot of potential use in biology and medicine," Brinster says.

In the second paper, Brinster and Mary R. Avarbock transplanted stem cells taken from fertile mice to the testes of mice with low or no sperm count. This time, the researchers showed, the procedure yielded mature sperm cells in more than 70 percent of the recipients.

A question remained: Could the recipient males sire a litter of pups?

To find out, the researchers mated two low-sperm-count mice with female mice. In the most successful case, 80 percent of the resulting pups came from donor-derived sperm and thus carried the donor dad's DNA.

"This is an exciting piece of work," comments Peter Donovan of ABL-Basic Research Program, a part of the National Cancer Institute located in Frederick, Md. Donovan points out that such research could lead to a treatment for infertility in men. Researchers might someday take germ cells from a man with a low sperm count, culture them in the laboratory, and use them to replenish the man's testes, he says.



Brinster

Following transplantation of stem cells from a fertile mouse to an infertile one, mature sperm (red dots) appear in the recipient's epididymis, a sperm-storage tube that connects the testis to the sperm duct.

Such research could also pave the way for germline gene therapy, the technique of replacing a disease-causing gene with a healthy gene in a cell that affects succeeding generations.

Theoretically, researchers could obtain germ cells from a man who carried a genetic flaw, explains Martin Dym, a cell biologist at the Georgetown University Medical Center in Washington, D.C. They could snip out the mutant gene and replace it with a normal one. The researchers would then transfer the corrected germ cells to the man's testes. Any offspring derived from those engineered cells would not carry the genetic flaw, he adds.

Scientists are already experimenting with somatic gene therapy, in which a desired gene is inserted in the DNA of a body cell that dies after a short period. With germline gene therapy, researchers would insert genes that get passed down to future generations.

Right now, such gene insertions remain risky. "It's premature to think about [germline gene therapy] in humans," Dym says. Yet, he adds, if scientists can iron out the glitches, such an approach would offer tremendous benefits. "Conceivably, you could use the technique to eradicate genetic diseases."

— *K.A. Fackelmann*

Element 110 makes a very fleeting debut

The heaviest known element has made a brief, though substantial, appearance in a German laboratory.

Researchers at GSI, the center for heavy ion research in Darmstadt, reported evidence last week of an isotope of element 110, with an atomic mass of 269. The atomic number indicates the number of protons in the atom, while its mass reveals the number of protons and neutrons.

The international team of scientists, led by GSI physicist Peter Armbruster, produced the element by bombarding an isotope of lead with nickel atoms. The two fused, producing an unstable, intermediate atom with an atomic number of 110 and a mass of 270.

That intermediate atom then ejected a neutron, stabilizing itself for 270 microseconds as the long-sought element 110 before undergoing a unique chain of decays. The researchers meticulously recorded the emission of four alpha-particles, each a helium nucleus with two protons and two neutrons.

Observing this distinct decay pattern — as element 110 spawned daughter and granddaughter isotopes 108 to 102 — permits researchers to confirm the presence of the parent element 110, says Armbruster.

To produce a single atom of element 110, the researchers used the UNILAC accelerator at GSI to bombard a target of lead over many days with more than a billion billion nickel atoms. A detector system searched each collision for element 110's distinct decay sequence. Armbruster and his 12 coworkers detected the new element on Nov. 9, then hastily penned an article for the Nov. 14 issue of ZEITSCHRIFT FUER PHYSIK A.

"This is excellent work," says Albert Ghiorso, a physicist at Lawrence Berkeley Laboratory in Berkeley, Calif., who led the discoverers of element 106. "There's no question in my mind that they've actually found element 110."

In 1991, scientists in Berkeley, performing similar experiments, reported seeing evidence of element 110, but it was not confirmed. Meanwhile, in Dubna, Russia, researchers have experiments under way to produce an isotope of element 110 with a mass of 273 by bombarding plutonium with sulfur. Other experiments at GSI are pursuing more heavy isotopes.

"This is all very exciting," says Ghiorso. "Who knows, we may see more isotopes before the year's end. That would be magnificent."

— *R. Lipkin*