The give and take of Parkinson's treatment

Two surgical treatments for Parkinson's disease—one that transplants cells into a patient's brain and another that destroys some brain tissue—show promise in recent studies. However, the first operation is controversial, and the second poses clear risks to the patient.

In Parkinson's disease, the brain lacks dopamine, a vital neurotransmitter. Its absence leads to tremors, muscle rigidity, and other problems in motor control. Brain surgery for Parkinson's was tried in the 1950s and early 1960s but was shelved in 1967. That year physicians began prescribing the drug levodopa, which the body processes into dopamine. Unfortunately, levodopa's beneficial effects diminish over years of use.

In the late 1980s, doctors took the radical step of transplanting healthy neurons into the brains of Parkinson's patients. The surgery, intended to spur dopamine production, drew criticism because it uses human embryo cells.

In a study started in 1995, doctors at the University of Colorado Health Sciences Center in Denver injected fetal cells into 20 Parkinson's patients, one of whom later died in an unrelated accident. The surgeons injected an inert substance into 20 others. A year after surgery, dopamine production had risen in 13 of the 19 treated patients. Among those 13, the patients under age 60 scored better in movement tests than they had before surgery.

The 20 untreated patients showed no increase in dopamine production, Curt R. Freed, a neuroscientist at Colorado, reported last month at a meeting of the Society for Neuroscience in Miami Beach, Fla. After the year-long test concluded, 14 of the untreated patients elected to have surgery, Freed says. He continues to track all the patients' progress.

Meanwhile, Swedish and British scientists report that after 10 years, a 69-year-old Parkinson's patient is still showing benefits from surgery that implanted embryonic cells into one side of his brain. The transplanted cells are still making dopamine and haven't succumbed to whatever destroyed his original cells, the team reports in the December NATURE NEUROSCIENCE.

Moreover, the scientists ascertained for the first time in a Parkinson's patient that dopamine made by the transplanted cells is being released and used, as researchers had assumed, says study coauthor Paola Piccini of the Imperial College School of Medicine in London.

In Parkinson's patients, dopamine-starved brain cells make extra receptor molecules to capture what dopamine is available. To test for this overabundance, Piccini and her colleagues injected the patient with radioactive chemicals that highlight such receptors. They found that the side of the brain that had received the cell implants had appropriate amounts of receptors—indicating that the implanted neurons were sending dopamine across synapses to host neurons.

The Europeans "have done an excellent job following a few patients very closely" and showing dopamine release, Freed says.

An opposite surgical approach inserts a hot needle into one side of the brain to destroy a small portion of the globus pallidus, an area that's hyperactive in many Parkinson's patients. The technique was discovered 4 decades ago, when surgery accidentally damaged the globus pallidus in a Parkinson's patient—whose motor control subsequently improved.

In a new study in the Netherlands, 18 patients who underwent the surgery raised their scores significantly on standardized movement tests during the following 6 months, says Rob M.A. de Bie of the University of Amsterdam.

The operation carries risks, however. Two patients showed serious adverse reactions, such as psychosis, and seven others had milder effects including facial paralysis, the scientists report in the Nov. 13 LANCET.

Still, this kind of surgery is "the most important therapeutic advance in Parkinson's disease" since levodopa, says Niall Quinn of the Institute of Neurology in London, writing in the same journal. *— N. Seppa*

Physics rule of thumb gets thumbs down

When intellectual giant Niels Bohr offered a striking new atomic theory in 1913, he and the field of physics unwittingly benefited from a large dollop of dumb luck, physicists say. Bohr analyzed energy levels of the hydrogen atom, which consists of two charged particles. For interactions of such particles, the quantum mechanics theory that Bohr was helping to establish happens to yield predictions that at high energies match exactly those of classical physics.

Now, a theorist has explored the quantum-classical connection for interactions between neutral atoms chilled nearly to absolute zero. Bo Gao of the University of Toledo in Ohio finds that a principle developed by Bohr to help quantum pioneers develop a theory that dovetailed with classical physics gets left out in the cold.

Bohr proposed a rule of thumb called the correspondence principle (SN: 1/11/86, p. 26). A form of the principle widely repeated in textbooks and lecture halls states that predictions of quantum mechanics and classical physics should match for the most energetic cases.

In the Nov. 22 PHYSICAL REVIEW LETTERS, Gao calculates possible energy states of any chilled, two-atom molecule, such as sodium, that's vibrating and rotating almost to the breaking point. He performs the calculations via quantum mechanical and so-called semiclassical methods and compares the results. Instead of the results agreeing better for increasingly energetic states, the opposite happens.

According to quantum mechanics, Gao explains, atoms behave as both particles and waves. As scientists make atoms colder and more sluggish, the particles' wave nature spreads over a larger space.

For charged particles in high-energy states, this wave property remains small enough that the correspondence principle holds. For neutral atoms, however, which have different forces between them, the wave aspect can't be ignored. As long as the particles' wave nature remains noticeable, quantum and classical pictures can't look the same.

"This is not to say that anything in quantum mechanics is incorrect," Gao notes. It's "just that some particular formulations of this quantum-classical correspondence are wrong."

"It would be nice if this permeates into the quantum mechanics textbooks," comments Chris Greene of the University of Colorado at Boulder. But don't expect a big impact on research, he cautions. Quantum mechanics specialists have recognized since at least the 1930s that both the correspondence principle and classically based approximations of quantum mechanics can only be trusted to a limited extent, he says.

Gao agrees that the Nov. 22 report mainly sends a message to teachers and textbook writers. He told SCIENCE NEWS, however, that in unpublished work he extends his ideas into a new mathematical description of ultracold atoms that are colliding or weakly bound to each other. This broader theory should strongly affect both atomic physics and chemistry, he says.

For now, researchers rely on computers to predict the behavior of atoms in ultracold gases (SN: 9/11/99, p. 166) such as Bose-Einstein condensates or to model strained bonds in cold but excited molecules. However, for each type of atom, say sodium or rubidium, researchers must generate a different set of equations and numerical solutions, Gao says.

By contrast, his unpublished theory unifies the mathematics so that properties of the ultracold atoms emerge from relatively simple equations that can be solved on paper, he says.

While Gao's new theory is promising, the brute-force computers have become so fast that the numerical approach is already beginning to succeed, Greene contends. At the same time, a shortage of experimentally determined parameters hobbles on-paper solutions, he adds. *—P. Weiss*