

Peter Chase and Barbara Davis Center colleagues are shaping the future of diabetes management

“BIONIC PANCREAS” ON THE HORIZON? *By Todd Neff*



Peter Chase, MD, (top right) with members of his research team; Victoria Gage, RN, with a prototype “bionic pancreas.”

It’s not easy to keep up with Dr. Peter Chase – just ask student researchers a half century his junior.

Chase, professor of pediatrics at the Barbara Davis Center for Childhood Diabetes, leads studies of type 1 diabetes (in which the body’s immune system destroys insulin-producing pancreas cells), authors “Understanding Diabetes” diabetes-education books, mentors young researchers and, not least, is a renowned diabetes clinician. Perhaps the best way to understand how all this fits together is to take a look at where he is headed.

Chase, 72, envisions a future in which patients with type 1 diabetes wear a combination of technologies that play the role of a normal

pancreas, enabling a constant fine-tuning of insulin delivery – and hence control of blood sugar levels – all day, every day.

Today, a growing number of patients keep tabs on their blood sugar levels with continuous glucose monitors, while insulin pumps administer small, regular of insulin over time from – as opposed to periodic injections that let blood glucose levels spike or sag.

The closed-loop, or “bionic” pancreas, will combine continuous glucose monitors with insulin pumps to automatically maintain blood sugar at optimal levels.

Bionic pancreas. Chase's work aims to take the science a step further, by connecting monitor and pump with what researchers on his team call the "navigation cradle," a device still in the works that will take the flow of information from the glucose monitor and calculate just how much insulin the pump should automatically dispense – or not dispense – at a given moment.

“This will revolutionize type 1 diabetes care as the technology develops.”

Call it a closed-loop pancreas, or, more evocatively, a “bionic pancreas.”

“We have to have continuous glucose monitoring, we have to have the algorithms to tell the pump when to shut off, and we have to have a reliable pump that will shut it off,” Chase said.

Chase's team is awaiting Food and Drug Administration approval to commence a National Institute of Health-funded home study of a prototype system. The focus will be on nighttime use: 55 percent of severe blood sugar lows in all diabetes patients happen during sleep, Chase said.

“They [the patients] don't make the hormones that respond to blood sugar in the same volume as during the day,” Chase said, in particular adrenaline and epinephrine.

Among children, 75 percent of such episodes happen during sleep. In the study, the system will turn off insulin pumps to allow blood sugar levels to recover.

Taking control is vital. Diabetes researchers have shown that maintaining tight control of blood sugar levels is vital to keeping the worst consequences of the disease at bay. Short-term risks include hypoglycemia – low blood sugar – which can trigger confusion, lethargy and lead to coma and death. Long-term, high blood sugar levels increase the risk of eye, kidney, nerve and heart problems, the Juvenile Diabetes Research Foundation International says.

Two-thirds of children have HbA1c levels (a measure of blood glucose over a period of two to three months) above eight percent, a full percent more than the 7 percent threshold of good control, Chase said. Lowering HbA1c from 8.5 percent to 7.5 percent cuts risk of long-term complications by 40 percent, research has shown.

Continuous glucose monitoring, which Chase helped pioneer and for which he has been a vocal advocate (*Insider*, September 23, 2008), is a key to keeping close tabs on blood sugar fluctuations, he says.

“Instead of knowing what your blood sugar is for four seconds in a given day, it’s now continuous,” Chase said.

Insurance companies are finally catching on, he said, recognizing that better control will improve health and save money in the long run. Insulin pumps, which fully 40 percent of the roughly 5,000 Barbara Davis Center patients wear, help those with continuous glucose monitors give themselves timely boosts of the hormone.

The future is now. It’s the intelligence connecting the two systems that remains the stuff of the future, Chase said. But his Barbara Davis Center group is hard at work to make it happen soon.

Earlier this month, Victoria Gage, RN, was among those training Chase research associate Lauren Horton on the prototype system. Gage, a childhood patient of Chase’s, wore a continuous glucose monitor on her left triceps and an insulin pump at her belt. The prototype navigation cradle, looking something like a homemade radio and powered by two ostentatious D-cell batteries, was wired to a laptop computer that acted as the brains of the system.

“We want to make things easier and safer for patients with diabetes,” Gage said.

Barbara Davis Center director George Eisenbarth, MD, PhD, said the approach will “revolutionize type 1 diabetes care as the technology develops. In particular, the long-term hope is that the devices will be good enough to remove the minute-to-minute attention that patients have to pay to their glucose.”

The work, in addition to Barbara Davis Center studies involving the prevention of type 1 diabetes, embodies a shift in the broad direction of leading-edge diabetes research that has been as much philosophical as technological, Chase said. From the time Chase began as the Barbara Davis Center’s lone full-time physician in 1980 (today the center has 20 physicians and another 15 PhD researchers), the holy grail of diabetes research has been to find a cure for the disease, most recently through introducing new human islet cells into the pancreas. But complications stemming from the need for immunosuppressants led to a rethinking of priorities, Chase said.

“The focus switched from a cure tomorrow to the best control possible today,” he said.

Those with blood relatives who are diagnosed with type 1 diabetes can schedule a free diabetes screening at the Barbara Davis Center. Call 303-724-6772 for more information.