

Courant.com

Hearts And Technology: Ongoing Innovations In Cardiology

BY WILLIAM WEIR, bweir@courant.com

8:08 PM EDT, April 27, 2012

Lori Turner, 53, was lying on a table in the electrophysiology lab at St. Francis Hospital and Medical Center, obscured by heavy equipment. Born with a rare, potentially fatal heart condition called Wolff-Parkinson-White syndrome, or WPW, the Mansfield resident was undergoing an operation that would fix the defect and end her periodic bouts of rapid heartbeat and dizziness. Cardiologist Joseph Dell'Orfano, the doctor performing the surgery, occasionally went into the operating room to make adjustments. Most of his work, though, was conducted in a room on the other side of a large glass window filled with computers and electronics.

Here he examined a three-dimensional image of Turner's heart on a 56-inch, high-definition screen. With keyboard and mouse, he controlled the four catheters wending their way through the chambers of her heart, seeking the rogue pathway that occasionally sends Turner's blood circulating in a small loop.

The operation was performed with the Epoch Robotic Magnetic Navigation system, which was installed at the hospital in early March. It's an upgrade of the remote magnetic navigation system that the hospital obtained in 2007. The system allows doctors to remotely steer the catheters inside the patient's body, aided by giant magnets on each side of the patient. Because the catheters in the new system are floppy, there's less chance of perforating the heart than with traditional catheters. With even more powerful magnets, the Epoch gives the operator more control, Dell'Orfano said, and is faster and more intuitive.

From the discovery of X-rays in 1895 and the invention of the electrocardiograph in 1902 to today, cardiology and technology have long been intertwined. Revolutionary breakthroughs and the many, smaller evolutionary advances on those breakthroughs are driven largely by competition among medical companies.

"Capitalism is a tremendous driving force for new technology," said Dr. Henry Cabin, medical director of the Yale-New Haven Hospital Heart and Vascular Center. "The companies are constantly trying to develop new things, because of the potential for huge profits. In their defense, they spend a huge amount of money for research and development."

Doctors, also driven to find better procedures and equipment, often work with the companies.

"There's a huge industry working with physicians to develop new products, and billions of dollars are invested," he said. "It's a huge upside for patients."

Cabin estimates that major breakthroughs happen every five to 10 years, but there are constant upgrades to the existing technology. Sometimes it's a chore sorting the real advances from the hype.

"There's a lot of new mouse traps, if you know what I mean," he said. "The problem for the public is that there's a lot of media hype in the press and advertising by hospitals, and some of the things aren't real breakthroughs, but another mouse trap."

Video Games And Joysticks

Dell'Orfano steered the catheters closer to the malfunctioning pathway in Turner's heart with a series of keyboard clicks and slight movements of a computer mouse.

"This is where PlayStation training comes in handy," he said. Once the cauterizing catheter was in place, he applied — again by keyboard — a series of 30-second applications of heat to the

pathway to eliminate it.

Looking at the screen to make sure he got it, Dell'Orfano declared: "She's cured."

Turner's lifelong condition, by all indications, was gone. She went home later that day.

Dell'Orfano's comment about PlayStation training was a joke, but many agree that younger doctors brought up on video games take more naturally to the new technology. One study, published a few years ago in the Archives of Surgery, found that doctors who regularly played video games — either as a child or adult — performed better on certain surgeries.

"There is a divide," said Dr. Joseph Akar, director of the Yale School of Medicine's Complex Ablation Program. "I don't know whether there's data about it, but I think that's absolutely correct that, when you are younger, you generally are more open to new things."

So many of the systems, whether robotics or remote magnetic navigation systems, employ joysticks and three-dimensional images, he said.

"They're very much like video games; younger doctors used to that thinking take to it," he said.

"I think younger people who grew up with video games like Wii and Ataris and Nintendo probably have the capacity to do that a little more readily than older physicians."

Andrew Epstein, a professor of medicine at the University of Pennsylvania and a member of the American College of Cardiology, agrees that being "born with a keyboard in their hands" can give some younger doctors an advantage, but he thinks that too much can be made of the generational difference. He was still using slide rules in medical school (pocket calculators were considered cheating), but said he has adapted well to the new technology. And, he said, the most cutting-edge device in the world isn't going to make learning the basic concepts of cardiology easier.

"Accepting new technology, I don't think it's an age thing," he said. "It has more to do with your personality — some people are more set in their ways."

Biodegradable Stents

Not all the breakthroughs in cardiology beep and come with joysticks.

"I think the next big thing will be biodegradable stents," Cabin said. Now, stents are made of metal and are intended to remain in the patient's artery forever.

"There are cases," he said, "where in one or two years, the stent will clot off because it's a foreign body" and require removal. But biodegradable stents, now in trial, are strong enough to buttress the artery for the first month or two and then disappear.

And last year at Yale-New Haven Hospital, doctors performed the first operation in the U.S. in which a tissue-engineered blood vessel was implanted into a patient. The operation fixed a rare congenital heart defect.

The patient, 4-year-old Angela Irizarry of Bridgeport, had received the first of two synthetic grafts shortly after she was born. But these kinds of grafts commonly have complications, such as clotting and infection. The operation, led by pediatric cardiac surgeon Toshi Shinoka and pediatric surgeon Christopher Breuer, involved generating and then implanting a blood vessel made from Angela's own bone marrow cells. Another problem with synthetic grafts is that they don't grow with the child, so numerous operations are required to replace them. But a vessel made from her own cells will grow with her.

Except for an infection that was successfully treated, the operation went smoothly, and Angela is now waiting for her immune system to get stronger before going to school.

Implanting Heart Valves

Cabin said one of the breakthroughs that has had a profound effect is a procedure known as transcatheter aortic valve implantation (TAVI) or transcatheter aortic valve replacement

(TAVR), which was approved by the FDA last year. It allows doctors, for the first time, to implant an artificial heart valve with minimally invasive surgery.

"We now have technology where we can replace the aortic valve with a catheter rather than do open-heart surgery," he said. For now, the procedure is limited to elderly patients and other people considered too high-risk for surgery.

For the procedure, doctors insert a valve into a catheter, which enters the body through a small incision near the groin and is threaded through a blood vessel to the aortic valve. The particular valve used for the procedure is known as the Sapien, developed by Edwards Lifesciences in Irvine, Calif.

"But my bet is that over the next five years, it will go from only the high-risk patients to pretty much everyone," Cabin said. "The results have been spectacular."

The Sapien valve is the only one used for the procedure, which gives Edwards a corner on the market for now. Soon, though, it likely will face competition from Medtronic, which has its own valve in trial. Dr. Robert Hagberg, chief of cardiac surgery at Hartford Hospital, said the hospital will take part in the trials of the Medtronic device, probably starting in June or July.

Hagberg said he's nearly certain that this valve will get approval, because it has some significant improvements over the Edwards device — easier to handle and more control, for instance. By the time that one's on the market, Hagberg said, Edwards will have another, improved version of the device in trial. And when that's on the market, he said, there will probably be a few other companies getting in on the action with their improvements over both the Medtronic and Edwards devices.

"It's very good to have competition," Hagberg said, "because it drives the innovation and it drives change."