

# Heart surgeons see innovations with tiny new pumps

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A new generation of cardiac devices scheduled for human trials in Europe and the United States next year has heart surgeons talking about a possible sea change in the treatment of patients suffering from the most severe level of heart failure, which affects 150,000 to 200,000 Americans a year and kills thousands.

Traditionally, many of these patients received mechanical heart pumps, which kept them alive until they could receive transplants. But with an aging population and a limited supply of donor hearts, a growing number of cardiologists around the country are discussing novel strategies: whether some older patients should just expect to live with the pumps, for example, and whether the newest models can be used as "bridges" for some patients while new treatments help their hearts recover.

Consider Susan Tretter.

When the 61-year-old resident of Montrose, Minn., met Dr. Benjamin Sun the day after Thanksgiving last year, she had already been read her last rites and was making funeral plans with family members gathered at her hospital bedside.

Her heart had ruptured, and only a thin sack of tissue surrounding it kept her alive. A simple cough could have killed her.

Alerted by Tretter's physician, Sun operated on her heart, redirected the blood flow and implanted a small, propeller-driven pump.

But instead of sending her home to wait for a heart donor, Sun and a team of doctors treated her as if she might recover.

Exactly six months later, Tretter's heart had healed enough to pump on its own, and Sun removed the device.

"I just love the little man," Tretter said last week. "I believe I have been given a second chance at life."

Sun is a cardiac and thoracic surgeon for the Minneapolis Heart Institute at Abbott Northwestern Hospital and a research physician for the Minneapolis Heart Institute Foundation with a background in molecular biophysics and biochemistry. He describes himself as an "old man" in the realm of heart pumps.

## **BEYOND 'THUMPERS'**

The first generation of pumps moved blood from the body to a chamber and then back again, much like a human heart does. Sun said these bulky pumps were nicknamed "thumpers" by hospital staff because of the noise they made. Patients moving around the hospital knew the location of every power outlet, he said, because the batteries lasted just 30 minutes.

The next generation of pumps, now in use, are much smaller and more efficient because they rely on high-speed rotors to move the blood. But they lack the ability to create a pulse and may not empty the heart chamber completely, an action that allows the heart to rest and perhaps heal.

A third generation of even smaller pumps coming on line next year also relies on rotors, but these pumps will be programmable to create a pulse. Sun and several other researchers hope that by adjusting the pulse rate

therapeutically, they'll be able to help restore heart strength and wean patients from the pumps.

Sun, a consultant to a California company that manufactures a widely used pump called the HeartMate II, helped direct large-animal studies for the HeartMate III. The device will go into clinical trials in Europe and the United States next year.

## RELAX AND RECOVER

In theory, the flow rate on new pumps can be turned up high to let the heart rest and then turned down to stress the muscle and test whether the pump can be removed, said Dr. Emma Birks of the University of Louisville.

Birks is one of the world's leading researchers in the field and was part of a famous study at Harefield Hospital in London that led to the removal of the pumps in 11 of 15 patients.

U.S. researchers haven't been able to replicate those results. Birks said that may have to do with the fact that the Harefield study, unlike its U.S. counterparts, involved patients with weakened hearts but no clogging of the arteries. The English study also used clenbuterol, a muscle-building steroid banned for human use in the United States.

A U.S. study that began about six months ago will test whether therapeutic use of modern heart pumps, together with aggressive drug therapy, can restore damaged hearts, Birks said. Then, perhaps, researchers will get permission to try clenbuterol again, along with other therapies, she said.

About half of the people suffering from congestive [heart failure](#) have normal arteries, Birks said. She hopes to show that about half of those

could recover to the point that they won't need [heart pumps](#).

While there's great enthusiasm for the concept of using pumps to restore weakened hearts, "in practice it's relatively uncommon," according to Dr. Peter Eckman, medical director of the University of Minnesota's mechanical circulatory support program.

Sun agreed. Just two patients treated at Abbot have had their pumps removed so far, he said.

The U's program is following more than 100 patients, Eckman said, adding that he can think of just three whose hearts have strengthened to the point where their pumps could be removed.

Not everyone likes the idea - even where it's possible.

Richard Balzum, 48, of Buffalo, Minn., has been living with a heart pump since February 2011. His heart has recovered to the point where it's stronger than an average heart, Eckman said, but Balzum is opting to stick with the pump.

Balzum said that he's HIV-positive and that he doesn't want to take a chance on a surgery that might lead to an infection. "Why risk taking it out?" Balzum said. "I don't have any concerns on the reliability of this device."

No one has a reliable formula for nursing damaged hearts back to health, due partly to the fact that heart failure has many different causes.

Eckman said some people sporadically get better and no one knows why. "That's the million-dollar question, " he said.

## **A SURPRISE RECOVERY**

Sun remembers the first time he encountered a heart that had recovered after the implantation of a heart pump. He was working under the famed surgeon Mehmet Oz at Columbia University in New York.

"I went to the operating room ready to do a heart transplant on a guy. When I opened his chest up, his heart was virtually normal on a heart pump. And I went, 'Holy crap!' "

Sun removed the pump, and the donor [heart](#) went to another patient.

The same sort of thing happened in a half-dozen more cases in the mid-1990s, Sun said. "It started the idea that some of these hearts actually get better," he said. "We don't know why, but they do."

Sun said hearts seem to improve on pumps for about three months, but then begin to falter. He said it's like a marathon runner who gets injured. It needs rest, but if it sits on the couch too long, it begins to regress.

"The next dialogue," Sun said, "is who gets a transplant."

The sweet spot for transplants is between 50 and 70 years of age. Perhaps those over 70 should get a pump and go home and those under 40 should just get a pump to see if they'll recover enough to have the device removed, Sun said. "We're not promising because we don't know enough," he said.

But if the pump-removal rate can be bumped up even a few percentage points, he said, "that's a big deal because we're saving more people."

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