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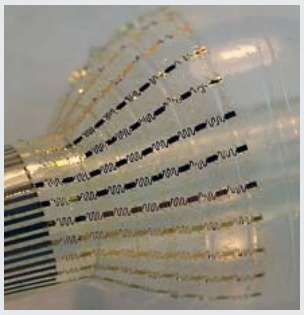

Surgical sensor: The surface of this balloon catheter is covered with a mesh of electrical and temperature sensors and wires.
Credit: Nature

COMPUTING

A Stretchy Sensing Tool for Surgery

An inflatable catheter covered with stretchy sensors could make cardiac procedures shorter and safer.

MONDAY, MARCH 7, 2011 | BY KATHERINE BOURZAC

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A new surgical tool covered in stretchable sensors could reduce the time required to map electrical problems in the heart from over an hour to just a few minutes. The tool could be one of the first commercial applications for an innovative method for making dense arrays of stretchable, biocompatible electronics using high-performance materials including silicon. The tool, which senses temperature and electrical activity, could also lead to better monitoring during other types of surgery, potentially reducing the rate of complications.

Putting such devices on a stretchy surface is not possible using conventional electronics manufacturing. The stretchable silicon electronics used were developed by John Rogers, professor of materials science and engineering at the University of Illinois at Urbana-Champagne and a cofounder of MC10, a startup that is commercializing the technology. Researchers at MC10 are leading the development of the catheters and are also developing the electronics for other applications.

The surgical tool has performed well in animal tests designed to mimic a disorder called atrial fibrillation. This results from electrical problems in the heart tissue around the pulmonary vein, which carries blood back to the heart from the lungs. The condition, in which the upper chambers of the heart quiver instead of beating, is seen in over 2 million Americans, and in 15 percent of all people who have strokes. Atrial fibrillation is difficult to control with drugs, and the drugs that are used, including blood thinners, can have serious side effects. But the problem can be corrected with surgery. First, surgeons map the source of the electrical problem with a probe, and then they knock out the electrical trouble spots by heating and damaging those tissues.

The new multifunctional surgical tools could help speed this surgery, lowering the risk that something will go wrong.

Mapping electrical activity in heart tissue is conventionally done using a tool called a balloon catheter—a soft, inflatable probe fitted with one or two electrodes. The catheter is moved back and forth over the damaged tissue, taking thousands of electrical readings one at a time, and these become the basis for a map of electrical activity. But the process is time-consuming—in the case of some fibrillations it takes over an hour.

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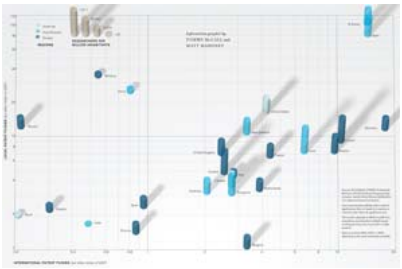

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(Page 2 of 2)

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The new catheter is covered in a mesh of hundreds of thousands of high-performance sensors and other electronics. It can be placed in the area of interest and inflated, making hundreds of thousands of contacts at once without the need to move it. When fitted with heating elements, it can also be used to perform the ablation—the destruction of the malfunctioning tissue—which normally requires the use of a second catheter. "You can keep it registered with the tissues and increase effectiveness and safety by being more accurate," says Marvin Slepian, a cardiologist at the University of Arizona Sarver Heart Center, who led the animal trials and is a cofounder of MC10.

The temperature sensors in the catheter also enhance safety. If the heart tissue gets too hot during surgery, it can fuse with esophogeal tissue, causing a fatal complication called a fistula. Temperature is currently monitored during surgery using a probe placed in the patient's esophagus. But by the time the tissue there heats up, it's often too late, says Slepian.

The results of the initial tests of the catheter are described this week in the journal *Nature Materials*. Slepian is now leading tests of the sensor-covered catheters in larger animals and is testing their use as a way to map and treat more complicated arrhythmias in the ventricles of the heart. He says the company is still deciding what path to take toward clinical approval of the tool, pending continued successful tests in animals. If clinical trials are required by the Food and Drug Administration, he says, it will be a few years before the tool reaches the market.

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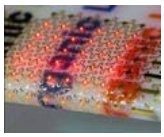

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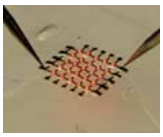

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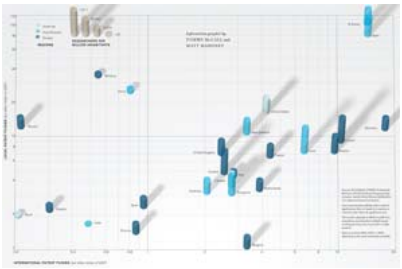

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It is exciting to see the use of sensors in medical devices for immediate data collection during surgery - lives will no doubt be saved!

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