Beating Heart Found To Power Pacemaker

An experimental device converted energy from a beating heart to provide enough electricity to power a pacemaker in a study presented at the American Heart Association’s Scientific Sessions 2012. The findings suggest that patients could power their pacemakers — eliminating the need for replacements when batteries are spent.

In a preliminary study, researchers tested an energy-harvesting device that uses piezoelectricity — electrical charge generated from motion. The approach is a promising technological solution for pacemakers, because they require only small amounts of power to operate, said M. Amin Karami, Ph.D., lead author of the study and research fellow in the Department of Aerospace Engineering at the University of Michigan in Ann Arbor.

Piezoelectricity might also power other implantable cardiac devices like defibrillators, which also have minimal energy needs, he said. Today’s pacemakers must be replaced every five to seven years when their batteries run out, which is costly and inconvenient, Karami said. “Many of the patients are children who live with pacemakers for many years,” he said. “You can imagine how many operations they are spared if this new technology is implemented."

Researchers measured heartbeat-induced vibrations in the chest. Then, they used a shaker to reproduce the vibrations in the laboratory and connected it to a prototype cardiac energy harvester they developed. Measurements of the prototype’s performance, based on sets of 100 simulated heartbeats at various heart rates, showed the energy harvester performed as the scientists had predicted — generating more than 10 times the power that modern pacemakers require. The next step will be implanting the energy harvester, which is about half the size of batteries now used in pacemakers, Karami said.

Researchers hope to integrate their technology into commercial pacemakers. Two types of energy harvesters can power a typical pacemaker: linear and nonlinear. Linear harvesters work well only at a specific heart rate, so heart rate changes prevent them from harvesting enough power. In contrast, a nonlinear harvester — the type used in the study — uses magnets to enhance power production and make the harvester less sensitive to heart rate changes.

The nonlinear harvester generated enough power from heartbeats ranging from 20 to 600 beats per minute to continuously power a pacemaker. Devices such as cell phones or microwave ovens would not affect the nonlinear device, Karami said. Co-authors are David J. Bradley, M.D., and Daniel J. Inman, Ph.D. Author disclosures are on the abstract.

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