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Wireless Fully-Passive Pacemaker

When fully implantable pacemakers were first invented, they were seen as a medical breakthrough device with the potential to help millions. The evolution of pacemakers since then has been swift and expansive. Despite this, current pacemaker systems suffer from several critical limitations including infection, thrombosis, tricuspid valve or ventricle perforation as well as problems associated with lead extraction. Additionally, because of access to lead implantation, current pacemakers are limited to right ventricular (RV) pacing or biventricular pacing with coronary sinus distribution. RV pacing creates abnormal left ventricular (LV) contraction and increases the risk of heart failure and death. Wireless systems have been introduced that enable LV pacing, however, they are ultrasound based and are energy intensive and have their own complications with location requirements.

Researchers at Arizona State University have developed a new generation of pacemaker technology which overcomes the limitations seen in current pacemakers. This wirelessly controlled, miniaturized system is battery-free and has the ability to be implanted in various cardiac locations. Because this system is wireless, the risk of venous and intracardiac thromboses, tricuspid valve injury, infection and RV perforation is significantly reduced. The increased flexibility in placement of this system, such as endocardial or epicardial implantation, could enable more precise and physiological pacing for optimum electrical activation and improved cardiac hemodynamics.

This next generation pacemaker system overcomes the remaining challenges with current pacemakers to reduce complications and enable individualized pacing protocols that are precisely tuned to a patient's hemodynamic needs.

Potential Applications

- Cardiac pacing
 - o Bradycardia
 - o Heart block
 - o Damaged sinus node from aging or heart disease
 - o Regulating heartbeat after medical procedures to treat arrhythmia or atrial

fibrillation

- o Cardiac resynchronization therapy
- o Long QT Syndrome
- o Congenital heart disease

Benefits and Advantages

- Wireless – reduces complications such as infection, thrombosis, tricuspid valve or ventricular perforation
- Compact electrodes – about 1 cm in diameter
- Does not require a battery, power regulator, or energy harvesting unit on the electrodes
- o Avoids local tissue heating effect
- Can be implanted in multiple cardiac locations for patient-tailored pacing
- o Avoids limitations associated with cardiac regions amenable for pacing

For more information about this opportunity, please see

[Liu et al - ACS Sens - 2017](#)

For more information about the inventor(s) and their research, please see

[Dr. Chae's laboratory webpage](#)